THIRD INTERNATIONAL ROAD CONGRESS, 1913.

REPORT

OF

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REPORT ON THE THIRD INTERNATIONAL ROAD CONGRESS, HELD IN LONDON, 23rd to 27th JUNE 1913.

Introduction.

Before commencing an account of the work accomplished by the Road Congress, it will be appropriate to refer to the Permanent International Association of Road Congresses, and to the creation, organisation, and objects of the British Road Board.

Permanent International Association.

The object of the Permanent International Association of Road Congresses, which has its headquarters in Paris, is to promote progress in the construction, traffic, and exploitation of roads.

It accomplishes its object—

1. By organising Road Congresses;
2. By publishing Papers, Proceedings, and other Documents;
3. By collecting the results of—(*a*) Tests carried out on roads; (*b*) Laboratory tests throughout the world on materials which are used or are suitable for road construction and maintenance; these tests may be either in the form of mere records collected by the Association or they may have been carried out by the Association itself or through its instrumentality.

Its affairs are managed by a Permanent International Commission, having its headquarters at 1, Avenue d'Iéna, Paris.

The Association consists of—

1. Delegates of Governments and Corporations of all the countries which subscribe annually to the Association.

   The term Corporation includes: Public departments, Provincial Governments, County, District, Communal, and Municipal Bodies, Chambers of Commerce, Scientific or Technical Institutions, Tourist and Sporting Clubs, Professional Associations or Trades Unions, Transport Companies, Industrial, Agricultural, and Commercial Societies or Companies, &c.

2. Private members.

   Membership may be either permanent or temporary.

   Governments may appoint one official delegate, with a right to vote at every Congress, for each 250 francs of their annual subsidy.

   This amount is reduced to 100 francs for Corporations.

   Permanent members are entitled to attend and vote at every Congress.

   Temporary members are entitled to attend the Particular Congress they have joined, and they may vote on all questions which do not affect the Permanent Association itself.

3. Honorary Members, nominated by the Permanent International Commission.

A Permanent Council and an Executive Committee are appointed from amongst the Members of this Commission.

The Permanent International Commission is composed of members belonging to the various countries represented in the Association. Each country has the right to one representative for each 1,000 francs of its total annual subsidy.

Provided, however, that the number of representatives from any one country shall not exceed 15 (fifteen) and that any country which pays not less than 250 francs shall have the right to appoint one delegate.

At the head of the Permanent Commission there is a President, a Vice-President, and a General Secretary, who together constitute the Executive Committee.

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This Commission—

1. Determines when and where the Congresses shall be held.
2. Arranges for the formation of a Local Organising Commission at the place selected for the Congress.
3. Determines the languages which shall be officially recognised by the Congress, prepares the Agenda and settles the questions to be submitted to the Congress, as also the nature and number of communications it shall deal with; arranges the business of the meetings; and appoints the writers of Papers on the several questions, &c.

The Executive Committee is composed of the President, Vice-President, and General Secretary of the Permanent Commission and of the Permanent Council. The Members of the Executive Committee shall belong to the country in which the headquarters of the Permanent Commission are situated.

The Executive Committee is responsible for the collection of records of experiments carried out on roads throughout the whole world and of laboratory tests on materials, &c.

It attends to the dispatch of current business, keeps the accounts, prepares the estimates of expenses to be defrayed out of the permanent funds of the Association, signs cheques and collects subscriptions.

It has charge of the library, archives, documents, and accounts.

It administers the funds of the Association.

It represents the Association in all judiciary actions.

It performs many other functions which are fully described in the regulations of the Association.

The permanent funds of the Association are derived from—

1. The annual grants from Governments and Corporations.
2. The subscriptions of permanent Members.

Permanent Membership involves an annual subscription of 10 francs. This subscription is increased to 25 francs for the first year in the case of Permanent Members who are enrolled during a Congress year.

Every Member is entitled—

1. To take part in the meetings of the Congress and to vote upon all questions figuring in the Agenda.
2. To receive the publications of the Congress, in any one of the languages recognised by the Congress.

Permanent and honorary members are further entitled—

(*a*) To lay before the Permanent Commission any questions to be submitted to the Congress. Such questions, accompanied by a concise report giving reasons for the same must reach the Commission at least one year before the Meeting of the Congress.

(*b*) To vote on all questions depending on the Permanent Association at the meetings of the Congress at the special meeting.

(*c*) To receive the publications distributed by the Association at other times than during the sessions of the Congress.

The Congress comprises—

Two Sections: One for the construction and maintenance of roads and the other for traffic and exploitation.

These Sections may be subdivided.

Its proceedings consist of General Meetings, Sectional Meetings, Excursions, and Receptions.

As it would be clearly impossible for all papers to be read at the Congress owing to the limitation of time, a General Reporter selected by the Permanent Commission is appointed for each question, whose duty consists of submitting to the Congress a short review of the chief features of this question, together with a summary of the Papers which have been transmitted to him.

The General Reporter may give his own views and data, and he may arrange with the various authors for formulating joint proposals.

As the regulations of the Association are somewhat numerous and complicated, it has not been possible to describe them at shorter length. Even now I have only touched upon the main points, and I must refer the reader desirous of more detailed information to a perusal of the printed regulations, which can be obtained from the Secretary of the Association at the headquarters in Paris.

The Road Board. The Road Board was constituted under the Development and Road Improvements Fund Act, 1909, and the Treasury appointed on it the following members :—

Sir George S. Gibb, Chairman.
The Right Hon. Lord Pirrie, K.P.
The Right Hon. Sir John H. A. Macdonald, K.C.B. (Lord Kingsburgh).
The Lord St. Davids, and
Sir Charles D. Rose, Bart., M.P.

The powers of the Board are contained in the following enactments of the Act :—

Section 8.—(1) "The Road Board shall have power, with the approval " of the Treasury—

" (*a*) to make advances to county councils and other highway authorities in respect of the construction of new roads or the improvement of existing roads ;

" (*b*) to construct and maintain any new roads ;

" which appear to the Board to be required for facilitating road traffic."

Section 8.—(5) " For the purpose of this Part of this Act the expression " 'improvement of roads' includes the widening of any road, the cutting " off the corners of any road where land is required to be purchased for " that purpose, the levelling of roads, the treatment of a road for mitigating " the nuisance of dust, and the doing of any other work in respect of roads " beyond ordinary repairs essential to placing a road in a proper state " of repair ; and the expression 'roads' includes bridges, viaducts, and " subways."

One of the first acts of the Board was to acquire offices and appoint their Staff. Mr. W. Rees Jeffreys was appointed Secretary, and Col. R. E. Crompton, C.B., Consulting Engineer.

In August 1910 an Advisory Engineering Committee was constituted by the Board with the approval of the Treasury.

The duties of the Committee are—

(1) To act as an Advisory Committee on such questions as may from time to time be referred to them by the Board for advice.

(2) To advise the Board as to matters in regard to which in the opinion of the Committee it will be advisable for the Board to have information or to take any action in order to promote or assist either general improvements or standardisation in methods or materials used in the construction or maintenance of roads, or in the collection and dissemination of information in regard to such matters or to road traffic statistics.

The Committee consists of the following members, in addition to the Chairman and the Consulting Engineer of the Board, who are *ex-officio* members :—

Mr. H. Percy Boulnois, C.E., late Deputy Engineering Inspector, Local Government Board.
Mr. John Brodie, C.E., City Engineer of the City of Liverpool.
Mr. P. C. Cowan, C.E., Chief Engineering Inspector, Local Government Board for Ireland.
Mr. H. P. Maybury, C.E., County Surveyor of Kent.
Mr. J. Walker Smith, C.E., Chief Engineering Inspector, Local Government Board for Scotland.
Mr. John Willmot, County Surveyor of Warwickshire.

The Road Improvement Grant, which the Board have to administer, arises from the Motor Spirit Duties and Motor Car Licence Duties imposed

by the Finance Act, 1910. On the basis of the Treasury Estimates the Board decided to adopt £1,000,000 as the basis for their first distribution of grants.

The amounts actually credited to the Road Improvement Fund up to 8th July 1911 in respect to the financial years 1909-10 and 1910-11 have aggregated £1,161,311 18s. 10*d.*, made up as follows:—

	£	s.	d.	£	s.	d.
Motor Spirit Duties:—						
In respect of the financial year 1909-10 - - -	290,702	15	9			
In respect of the financial year 1910-11 - - -	410,376	5	7			
				701,079	1	4
Motor Car Licences:—						
In respect of the financial year 1910-11 - -				460,265	17	6
				£1,161,311	18	10

The Board, after calling upon the Local Authorities of England, Ireland, and Scotland for a statement of their requirements, took up the consideration of certain questions of general policy on which it was necessary, within wide limits, to adopt some general line of action, and arrived at certain provisional conclusions in regard to these questions as far as they affected the distribution of their first grants.

It appeared to the Board to be sound policy to endeavour, in the first instance, to make the most of existing roads and to improve and utilise these to the best advantage.

The Board also decided that as a general principle it would not be advisable to begin by selecting a few large works in a limited number of places, but that the immediate and ultimate benefit of the Road Improvement Fund would be enhanced if in the first instance grants were widely distributed, thereby securing, as far as practicable, the initiation of improvements in each county, and so that such grants might not only provide financial assistance to useful works which many Local Authorities are anxious to carry out, but might also operate as a stimulus to improvements by all Local Authorities.

As regards the character of the work of road improvement towards which the first efforts should be directed, the Board in their first annual report say:—

"The condition of road crusts is, however, a most urgent problem. Upon "that depends both the alleviation of the intolerable and injurious nuisance "arising from mud and dust, and also the mitigation of the burden of "increasing cost of maintenance which is causing such widespread appre- "hension. Many miles of important roads in nearly every county are not "constructed or surfaced so as to be suitable for motor traffic; and, on the "other hand, the motor traffic, which on surfaces properly constructed and "bound with bituminous binding material probably causes less damage and "wear than is caused by horse-drawn traffic, is destroying and wearing "existing water-bound surfaces in many districts to such an extent that "the cost of the frequent renewal which they require to keep them in fair "condition imposes on the ratepayers quite a considerable burden."

In view of these considerations, the Board decided in dealing with applications for grants for the improvement of road crusts to encourage the use of bituminous binding materials. The Advisory Engineering Committee consider it essential, in order to obtain strong and durable surface which will bear modern traffic, that the old water-bound system of reconstruction should be superseded by the use of some bituminous binding material on all important roads which have to carry heavy and fast traffic.

Before making grants, the Board have found it necessary to hold conferences with representatives of most of the County Councils, with a view to settling the works of road improvement which are to be carried out within each administrative county.

Up to the 30th June 1911 the Board had received applications for advances amounting in the aggregate to £7,870,459, and made grants amounting in the aggregate to £263,324 and loans amounting to £7,500.

Mutual steps were taken during the year towards establishing at the National Physical Laboratory at Teddington a laboratory for testing, and experimental and research work in connection with road materials.

From information contained in the second annual report of the Road Board for the official year 1911–12, it would appear that the income of the Road Improvement Fund in respect of the period from the constitution of the Board in May 1910 up to 31st March 1912 was £2,184,314 6s. 11*d.*, made up as follows:—

	£	s.	d.	£	s.	d.
Motor Spirit Duties in respect of year—						
1909–10 - - - -	200,702	15	9			
1910–11 - - - -	410,376	5	7			
1911–12 - - - -	541,119	0	0			
				1,242,198	11	4
Carriage Licence Duties in respect of year—						
1910–11 - - - -	460,265	17	6			
1911–12 - - - -	370,036	0	0			
				830,301	17	6
Interest from Investments in year—						
1910–11 - - - -	4,851	16	0			
1911–12 - - - -	23,064	13	7			
				27,916	9	7
				£2,100,416	18	5

The Grants and Loans made and indicated during the same period to County Councils and other Highway Authorities amounted in the aggregate to £1,177,438, and in addition thereto the Board indicated their willingness to grant £875,000 to assist the construction of a new Western Approach Road to London.

The report lays special emphasis on the ever-increasing volume of traffic carried by the roads throughout the United Kingdom. The cost of maintenance, which has gone up by leaps and bounds, has affected all roads, whether urban, inter-urban, or rural. With the continued growth of heavy commercial motor traffic, roads which stood fairly well under the lighter horse traffic proceeding at slow speeds, are now going rapidly to pieces, and it is this, combined with the increase in traffic volume, that has up to the present time created the chief difficulties with which urban authorities have had to grapple.

To give some idea of the growing cost of road maintenance the following statistics have been extracted from the report:—Total expenditure of extra metropolitan county boroughs in England and Wales on road maintenance increased from £681,696 in 1890 to £1,169,170 in 1902, an average increase at the rate of 5·9 per cent. per annum, and to £1,235,906 in 1909, being a further average increase on the original figure at the rate of 1·4 per cent. per annum, the total increase in 19 years being 81 per cent.

And no alleviation of expenditure for many years to come would seem to be indicated. The roads of England are having a very great strain imposed upon them due to the use of heavier and more speedy vehicles, and in a very large number of cases the only solution would appear to be the complete reconstruction, not only of the wearing surface but of the foundations of roads, which experience shows are inadequate to stand the wear and tear to which they are subjected.

The Road Board are endeavouring to overcome the difficulty arising from the inability of Highway Authorities to provide, out of rates, sufficient sums to meet the extra initial expenditure required for recoatings in improved materials of a sufficiently large mileage of important roads by making advances by way of loan in these cases in which the work proposed is on the border line between maintenance and improvement. The Board are prepared, so far as their funds permit, to advance such loans in most cases *without interest* for the extra cost of road crust improvements which are likely to increase the life of surface coatings on a greater ratio than the increase of cost.

The Board have had a traffic census taken in most of the counties in England. From these returns, which are confined to main roads, the heavy

increase in motor traffic is very noticeable, ranging from 7 to 91 per cent. of the total traffic on the East Sussex roads and from 8 to 75 per cent. of the total traffic on the Kent roads, which latter by the way are generally admitted to be the finest roads in the world.

Negotiations by the Board in regard to the scheme for a new western approach road in London were continued during the year under report. This scheme is regarded as one of the most desirable works of its kind in the public interest at the present time.

Standardisation of road metal.

Steps have been taken by the Board to set in motion arrangements for standardising the gauges of broken-stone used for road-making. This work is proposed to be entrusted to the Engineering Standards Committee at the cost of the Board. The result of the labours of the Committee was seen at the exhibition held at the Horticultural Hall in connection with and during the week of the Road Congress, and their conclusions should be made public before very long.

The adoption of a standard gauge for road metal, based on scientific and practical investigations, will be of the greatest value to engineers, who, up to the present, have not, in the majority of cases, devoted that close attention to a subject which is of such fundamental importance in the construction of a good road.

Having regard to the international scope of the Congress it may be considered that undue prominence has been given to the British Road Board in this report; my excuse must be that in no other country does there appear to exist a similar organisation; and that, therefore, from its unique character it is deserving of special mention. This useful and powerful body has done and is doing much to improve the roads in Great Britain, and its influence will be increasingly felt as time goes on in its efforts to secure for Great Britain, both by precept and example, the finest roads in the world.

Report.

In the introductory of the general programme of the 3rd International Road Congress it is recorded that the first International Road Congress took place in Paris five years ago, and was continued by the Brussels Congress in 1910. The international character of the organisation can best be appreciated by the fact that no less than 36 different countries were represented at the recent Congress in London. At the second Congress we were told that "Experience has proved that roads can be built of "bituminous material which are not only practically dustless but are also "capable of carrying the heaviest ordinary traffic."

This being the case the question of administration assumed a more prominent position in the programme of this Congress. The Paris and Brussels Conferences confined themselves entirely to the technical aspect of the question.

The Congress was opened at a General Assembly at the Central Wesleyan Hall by the Chancellor of the Exchequer, the Right Hon. D. Lloyd George, M.P., while the Road Exhibition arranged at the Royal Horticultural Hall was inaugurated by the First Commissioner of Works, the Right Hon. Earl Beauchamp.

Receptions and Conversaziones for the members of the Congress were held at the Guildhall of the City of London; at the Albert Hall, by the invitation of the Institution of Civil Engineers; and at the Royal Automobile Club, while there was a Banquet, by way of conclusion to the Congress week, at the Hotel Cecil.

A large number of interesting excursions, on several of which many types of road construction were seen was arranged, both during the Congress and in the preceding and following weeks. A summary of inspections and excursions is contained in the Programme, a copy of which is attached to the report. The programme also gives full details of the picturesque features of these various excursions, together with technical notes on the roads which were inspected, and a list of the papers submitted for consideration at the Congress, with names and descriptions of their authors. The importance of the London Congress may be gauged by the organisation, which includes H.M. the King as Patron, and five members of the Cabinet as Honorary Presidents.

An important Exhibition of road-making appliances and materials was held during the Congress week at the Royal Horticultural Hall and the adjacent ground in Vincent Square, Victoria Street.

The exhibits were divided into four classes, as follows:—

Class 1, Materials and Tools; 2nd Class, Traffic; 3rd Class, Models, Maps, Drawings, and Publications; and 4th Class, Historical.

Exhibition of Road-making appliances and materials.

Section 1 included samples of stone, broken and chipped, tars and pitches, bitumen and asphalt, various surfaces, and testing apparatus. Section 2 comprised rollers, steam dryers, tar macadam mixers, breakers, scarifiers, &c. There were three sections in Class II. Section 1 consisting of mechanical vehicles for the transport of road materials; wheels and tyres designed to carry heavy weights without damage to the roads; non-skid apparatus not damaging the roads, and light railway and tramway tracks. Section 2 was devoted to horse-traction exhibits, such as wheels and tyres, non-injurious horse-shoes and shoeing with special reference to securing foothold. Section 3 included exhibits of appliances for highway and vehicle illumination.

Class III., in addition to exhibits defined in the title, comprised statistics, forms of accounts, meteorological records, &c., while in Class IV. were shown sections of road construction, old and new, and various historical exhibits.

The Chancellor of the Exchequer, in his inaugural speech, pointed out that the problems the Congress had to consider were of first-class importance to every civilised community, as they affected the comfort, convenience, and also the lives of the people. He observed that with the advent of rail-roads many of our roads appeared to fall almost into desuetude. Then came the great revolution effected by the pneumatic tyre, "and all the roads were " filled with dust and delight once more." The Chancellor said:—"One " thing had to be borne in mind, and that was that the more you improved " communications the less you spent on distribution, and the less you spent " on distribution the more was left for production."

He referred briefly to the Road Board and its work during the few brief years of its existence, and concluded by saying that some of the ablest men, representing 36 foreign Governments, would be present to contribute their science towards the solution of the important question of communications.

An important speech by Sir George Gibb, the President of the Road Board, followed. After tendering thanks to all who had co-operated in the arrangements for the Congress he referred to the valuable support received from the associations in the United Kingdom interested in road questions, and thanked the writers of papers, the various organising committees, and the many authorities, institutions, and associations for hospitalities in connection with the Congress meeting.

Sir George referred to the rapid development of motor vehicles, which had revolutionised the use of roads and unsettled the conditions on which road engineering were based; the problem of placing on a practical and equitable basis the relations between finance and improvement; the respective advantages of centralisation and devolution and of State management as compared with local administration, and concluded his remarks by welcoming the delegates on behalf of the Local Organising Committee.

As previously mentioned it was necessary, in order to get through the business before the Congress, to frame special byelaws which state that the work will be undertaken by two sections, each of which will be divided into two subsections.

Discussions in each subsection were absolutely independent of one another, but when two subsections met together for the consideration of a question of general interest, the meeting was presided over by an Executive Committee formed of the Executive Committees of the two subsections, with a Chairman, who was nominated beforehand by the Permanent Council.

"Questions" were discussed at the Sectional Meetings and afterwards at a General Meeting.

The discussion at each Meeting was preceded for each "Question" by a brief summary of the papers by a general reporter appointed by the Commission.

The Meeting was then thrown open to discussion. Speakers were allowed to use their own language, and were requested within 24 hours to deliver to the Sectional Committee a summary of their remarks.

After discussion of each "Question" each section appointed one or more reporters to support in General Meeting the conclusions they had adopted.

As it was not possible for me to attend all the sectional meetings, I attended those dealing with Questions which fall more definitely within the province of the Civil Engineer, such as Planning of new Streets and Roads and the construction and maintenance of roads generally. I have, however, perused a number of the papers and communications dealing with the work of sections at which I was unable to be present, and I have made full use of the information so obtained in this report. The resolutions passed by the Congress in respect of all subsections find a place in the report.

1st Question.--Planning of New Streets and Roads.

Subsections A. and B.

Planning of New Streets and Roads. Professor S. D. Adshead, General Reporter.

Several of the reports contain valuable information on the relative merits of cutting new streets through back land, and widening narrow but important arteries.

It seems to be the general opinion that the former method is the most economical and best, and cases in support of this are referred to by Messrs. Adams, Riley, Lancashire, and Stilgoe in their illuminating papers on the subject. Mr. Verstraete (Belgium) advocates the linking up of a system of narrow and less important streets in preference to widening main ones.

On the Continent, local authorities do not apparently possess powers to expropriate land in addition to and adjacent to that precisely required for the road.

In England, powers already exist under the Road Board Act whereby in the construction of a new main road the Road Board have authority to acquire land on either side of the proposed road within 220 yards from the middle of the proposed road.

It is the general opinion that the conditions of betterment need to be more clearly defined, and, as the General Reporter says, "it will be found "better in practice that in designing the lines of such new streets it is "better to disturb one ownership and occupancy *en route* than to strike "a boundary line which disturbs two."

By-pass Roads.

By-pass Roads.

Practically all are agreed as to the advisability of constructing by-pass roads around towns of secondary importance, which lie in the course of main roads, instead of widening existing ones passing through their centres; a plan which in execution always temporarily and often permanently disturbs important interests.

At the same time it has been pointed out by Mr. Stoelet (France) that such diversions of traffic are not always well received, and would often be against local interests.

Longitudinal Sections.

Longitudinal Sections.

Considerable divergence of opinion exists regarding the limitations of grade in the longitudinal sections. It was pointed out that the question of gradient is closely connected with the character of the road surface, its alignment, and the sort of traffic which preponderates in the particular district under consideration.

Generally, however, 5 per cent. seems a reasonable limit for the gradient of main roads outside towns.

Curves.

Curves.

Here again considerable divergence of opinion seems to exist. The German authorities refer to radii of 30 metres in mountainous districts; but

the bulk of opinion is in favour of curves of much greater radius, and there was a suggestion that 500 metres might be adopted as a suitable limit.

The definite object to be aimed at is to obtain an uninterrupted view of both sides of the road, which will allow of the fastest vehicles passing each other without danger and without slackening speed. The English authorities and Mr. Lewis of America suggest that there should be an unobstructed view of 300 ft.

The fact that all traffic slows down on steep gradients makes it reasonable to allow a reduction in hilly districts.

Cross-sections.

Cross-sections.

For main thoroughfares leading out of towns the desirable section advocated is one which provides separate ways, as follows: Fast traffic in the centre, slow traffic at the sides, and wide pavements at the outer edges. On the continent of Europe, particularly in Germany, multiple track systems are meeting with much favour, and are rapidly on the increase. Separate tracks are provided for equestrians, cyclists, and motorists, in addition to pathways and the tracks for ordinary traffic.

A width of 40 ft. is generally considered a minimum for the main streets of towns. As regards country roads no minimum is laid down, but they should be of sufficient width to allow of two laden carts passing comfortably.

In constructing roads where a gradual increase in traffic is anticipated, 16 feet is regarded as a minimum width to be metalled in the first instance.

Cross-fall roadways.

The tendency of all vehicles to make use of the most comfortable track induces drivers to keep to the centre of the road, and this tendency becomes more pronounced the steeper the fall of the road. Especially with motors which are liable to side-slip, very steep cross-falls on metalled roads should be carefully avoided. While formerly it was the general practice in most countries to camber roads to a circular, parabolic, or compound curve, it has now become the general rule, in order to avoid over-steep haunches, to make wide roads with straight sides, but rounded at the top for a width of about 3 or 4 ft., the cross-fall being made as flat as possible. The latter, however, should under all circumstances be sufficient to draw off the water to the gutter to prevent it from flowing down and scouring holes in the road surface. In countries like India, where very heavy falls of rain occur in a short time, the roads in hilly tracts are protected from erosion by the practice of constructing low earthen banks (bunds) at an angle across the roads at frequent intervals, in order to conduct the water as rapidly as possible into the side gutters. Without some such expedient as this the "blindage" is at once removed, and in a very short time the macadam is scoured away.

Position of trams.

The position to be occupied by trams has received a good deal of attention in most countries. In roads of normal width the centre is considered to be the best position. The advantage of the central position is that it is less costly and enables cars to take curves into side streets at a better radius. In streets lined with shops the central position admits of vehicles being drawn up alongside the curb, which would be quite impossible, without causing inconvenience and delay, were tram tracks located at the sides.

Where possible, streets taking trams should be sufficiently wide to allow of two rows of traffic passing on either side between the trams and the pavement.

The best arrangement of all is, of course, a separate reservation for trams, but this is only possible in the widest roads, and quite out of the question in the older cities, where the widths of roads were fixed without any conception of the enormous increase in the volume of traffic that the future would bring.

Central refuges, lamp standards, and posts are generally considered obstructive.

Width of pavement.

Regarding the width of pavements, much depends on the service of the street. Whereas in the suburbs a pavement of 5 or 6 ft. in width would suffice, in many shopping streets a width of 10 ft. would be permanently obstructed by people looking into the windows.

The General Reporter of this section observes: "It might be pointed "out in connection with the cross-section of streets that any diversity of "opinion which obtains regarding their relative width and section arises "very largely out of a need for the recognition of the kind of service which "they are constructed to take. In past times, when the organisation of a city "was comparatively simple, a standard of width which depended alone upon "density of traffic was sufficiently accommodating to meet different needs, "but in the modern city, where the social organisation and the allocation of "areas were definite, *standardisation in width should be supplemental to "classification of kind.*"

Crossings.

Crossings.

Generally it is agreed that central islands, lamps, and other obstructions are best placed in the centre of crossings at main collision points, and that entering streets are best splayed. The system recently in vogue and advocated by some writers of dotting crossings with a number of isolated islands and lamp standards, with a view to the better direction of traffic, does not appear to have gained general acceptance, and a reversion to the simpler system of large central refuges with powerful lights seems likely. The gyratory system of traffic direction finds favour in France, and a good practical example of this may be seen in Paris at the Étoile—the large central space at the top of the Champs Elysée, where the Arc de Triomphe is located. This system does not appear to have been established outside France, as in practice it is found to exact unnecessary discipline. As the General Reporter truly remarks, great volumes of traffic need to be controlled at crossings by the police, and, in plotting island refuges and obstructions, the point to be kept in view is how best to assist the police.

Two contributors of papers touch on the subject of the position of railways relative to large towns, and they both advocate taking the trunk railway line approximately through the centre of the town and encircling the town with a loop line. The same authors advocate the location of the industrial area between river and town, and of arranging park systems radially.

The Artistic Appearance of Roads.

The artistic appearance of roads.

Only two of the authors of the reports submitted draw serious attention to the importance of considering the artistic appearance of streets. One of them bewails the lack of interest taken by engineers in this aspect of the subject, and those who have fought against the tendency of councils and corporations to regard the laying out of towns and planning of streets from a purely utilitarian standpoint will agree with the remark "that if the "apparent indifference of engineers to take interest in the subject continues "much longer they will find that this branch of their profession will pass "into other hands."

It must be remarked, however, that these two authors write from Bruges and Ghent, two of the most picturesque towns in the world, and though they ought surely to be regarded as authorities on this aspect of the subject, their view in connection with artistic matters may be regarded by those living in more modern cities as somewhat restricted.

The General Reporter refers to them as "educated in the School of "Camillo Sitte, and imbued with the beauties of the picturesque they are "Romanticists of confirmed opinion," and it is necessary to appreciate this, correctly to understand the theories they advance.

Mr. Verstraete (Belgium) disposes of the chessboard and spider-web plans as being unnatural, and asks for the plan of each street to be decided on a minute analysis of requisite conditions. To obtain shade in the hottest part of the day he would avoid a north and south direction, and he would also avoid the direction of prevailing winds.

He lays down artistic principles to be borne in mind, which may be summarised as follows:—

Æsthetics of town planning.

1. Avoid straight tracks.
2. Avoid hogback longitudinal sections with no apparent ends.
3. Main streets must be long, curved, variable in width, and relieved from monotony by projections, recesses, &c.
4. Crossings may be arranged at triangular or rectangular spaces.

After reading the views of Mr. Verstraete it is interesting to turn to the report of Mr. de Vaere, also a Romanticist with an eye to the beauties of Nuremburg, Rothenburg, and Venice. There is much truth in his outspoken assertion that "it requires the modern scientist to crystallise the art of town "planning into a given number of 'Systems' such as the rectangular "system, the triangular system, &c.—the artistic value is nil, they are mere "exhibitions of pure technicalities, and their only object is to make the "design one of absolute regularity." He says, "The important point is not "the planning of the network of streets and open spaces themselves, a "problem which frequently falls to the engineer," and he sums up the demands made by art by the following axioms :—

1. Streets and open spaces should form architectural groups, and not a mere succession of buildings.
2. Streets and open spaces should be so arranged that the buildings appear to the best advantage to the spectator, and, as far as possible, they should come into view at a point from which they may be seen to the best advantage.

One would naturally expect very different theories to prevail in a city like Paris, where the wide straight boulevards of Baron Haussmann and his successors are the delight of Parisians and the envy of the world. The report of Mr. Stoclet (France) commences with a short treatise on "Haussmanising." He considers that straightness of line should be attained even at the cost of considerable financial sacrifice, and again he says, "It is "desirable that the straight line should be adopted when the surface slope "allows it."

Mr. Doubelir (Russia) is also an advocate of the straight alignment.

Where experts differ on matters of such fundamental importance the layman is at a loss to know what to think. But temperament and environment explain much as is well exemplified in the reports above mentioned.

Taking a broad view of the subject; regarding the modern city as a complex organism influenced by topographical, financial, social, and æsthetic considerations, he would be a bold man who would lay down dogmatically any one system of development as infallible. Obviously, the laying out of a city must, in the first instance, be governed by the nature of the site. A flat open plain—without a river—as a site for a city would lend itself to development by a combination of the chessboard and diagonal systems with circumferential roads at convenient intervals. A hilly, picturesque, country, gives greater scope to the artist and lover of curves and broken lines; while the presence of a river and a railway line at the site will introduce problems requiring the utmost skill in solution.

The following Resolutions were adopted by the Congress on the—

1st Question.—Planning of New Streets and Roads.

Resolutions adopted by the Congress.

1. As a general principle, it is better that new main roads be constructed to pass outside rather than through towns, and that, where an existing main road passing through a town is unsatisfactory for through traffic, it is often better in preference to widening an existing narrow main road through the centre of a town. New roads should be planned according to the principles of the science of town planning.

2. Gradients on new roads should be as easy as possible having regard to the physical character of the country through which they pass, and they should be easier where there are curves, trams, or a preponderance of heavy traffic.

3. The radii of curves in roads used by fast traffic should, where practicable, provide the best possible and an unobstructed view, and that where this is not possible, the curve being of short radius, means should be provided whereby the approach thereto is in some way clearly indicated.

4. Except where it is possible to provide special reserved spaces, tram tracks are best placed in the centre of the roads, and that where so placed it is desirable to provide space on either side for two tracks for vehicles.

5. The main traffic roads should be so designed that spaces are provided for tram tracks, fast and slow traffic, and standing vehicles; and in such a way that they can proceed without unduly intermixing. In fixing building lines along what may ultimately become main roads, regard should be paid to ultimate requirements. Adequate space should be provided between buildings, and powers for enforcing this should be held by all authorities who decide the widths of roads.

6. That the planning of main road communications outside towns should be at once undertaken; it is a matter of national importance in regard to which some initiative should rest with a central State Authority, and the action of Local Authorities should to some extent be regulated or supervised by Central Authorities.

2nd Question.—Types of Surfacing to be adopted on Bridges, Viaducts, &c.

Subsections A. and B.

Seven reports were presented to the Congress on this question.

At first glance this subject may appear so restricted as to afford little scope for discussion, but the reports show that such an impression is erroneous.

General Reporter P. C. Cowan, Esq., D.Sc., M.I.C.E., President, Institution of Civil Engineers of Ireland.

The report of Mr. Droune, of New York, tells us that the following types of surfacing are in use on Bridges in the United States of America—plank, wood block, sheet asphalt, stone block, brick, concrete, bituminous pavement, macadam, gravel, and earth.

Plank Flooring.

Plank flooring.

Plank flooring for bridges is largely used in Russia and Hungary where wood is plentiful. For movable and suspension bridges plank decking is in general use throughout the world, and the general method is to lay it in two thicknesses, the top or wearing surface being from 2 ins. to 2½ ins. thick and the bottom or supporting surface 3 ins. to 6 ins. thick, depending on the distance apart of the floor stringers. Messrs. Deuil and Bijls (Belgium) in their joint paper give some interesting particulars regarding the surfacing of the carriageway of movable bridges. They point out that lightness is an essential quality of movable bridges. Wood is a material which combines great resistance to bending with a light specific gravity. Hard woods, such as oak, have the disadvantage of being slippery for horses, and often the lower, or weight-carrying layer, is made of such woods, and the surface of a softer or less durable wood, but one which affords a sure foothold for the horses' feet.

In Belgium the bottom course is generally laid parallel to the axis of the structure. The planks are creosoted and laid with a space of about 15 mm. between them, which allows the water to drain through easily, and the timbers to be well aired and quickly dried. The average thickness is 7 to 8 cm. Such construction cost from 12 to 13 frs. per sq. m. The life is 15 years.

Latterly Jarrah wood from Australia has been used; it is more expensive than indigenous oak, but has been found more durable. It costs 20.50 frs. per sq. m.

Nearly all the indigenous woods have been tried for the top course, red pine being the most common. The life is one year only under heavy traffic, and the cost is about 7 frs. per sq. m. for the renewal of planks 7 cm. thick. Jarrah planking has also been used with excellent results. A life of four years under intense traffic is estimated. The cost is 9 frs. for planks 6 cm. thick.

Mr. Verrière (France) estimates the average annual cost of renewal of wooden flooring of this type at 5 frs. per sq. m., including the expense of coal-tarring the beams.

Wood Block Paving.

Wood block paving.

In Belgium the use of wood block flooring is greatly on the increase. A rolling bridge was paved with pitch pine blocks so as to reduce the weight, but they have only given mediocre results, so that Jarrah has been gradually substituted for them. Blocks that have been in use for 12 years are still in good condition.

The paving, which is 10 cm. thick, cost 18 frs. per sq. m., excluding laying. After laying, a mixture of creosote and pitch is spread over the surface until all the joints are well filled and the blocks quite covered. A layer of fine gravel is then spread over the surface so that it may penetrate into the joints and fibres.

Mr. Verrière gives the average annual expenditure of renewing wood blocks at 3 frs. 30 c. per metre as against 6 frs. for plank flooring. He estimates the life at from 10 to 12 years. Wood paving is as light as asphalt paving. It can be used on far steeper gradients than asphalt; it is perfectly elastic, silent, and gives easy running for traffic and can be used on carriageways carrying tram-lines. It is liable, however, to dangerous pressure through the expansion of the wood, owing to the effects of moisture.

Flooring of Mine Cables.

Revetment in ropes made of aloes.

Experiments were made in France about 1870 in substituting old ropes and hawsers, used in mines, for the top course of planking on bridges.

These ropes are made of "aloes." They deaden the sound like a carpet, and reduce the vibration which is so prejudicial to steel and iron structures.

They are placed lengthwise at right angles to the axis of the road, and must be packed closely together and nailed to a bottom course of ordinary timber planking. A paving of rope aloes laid on a bridge with a large amount of traffic has lasted six years.

This paving affords a good foothold for horses.

Some interesting experiments were carried out by the city of Antwerp with different kinds of flooring, and the results are given below:—

1. Planks of red fir or Canadian poplar, ·065 m. thick. Life, 8 months.

Cost:	Frs. per sq. m.
Timber	4·67
Sawing to length and trimming	·40
Laying	·20
Wrought iron nails, ·12 m. long, 1 kg., at ·45 fr.	·45
Total	5·72

2. Planks of Karri or Jarrah wood, ·065 m. thick. Life, 18 months.

Cost:	Frs. per sq. m.
Timber	10·00
Sawing to length and trimming and drilling holes for nails	·80
Laying	·20
Wrought iron nails, ·12 m. long, 1 kg., at 4·5 fr.	·45
Total	11·45

3. Flat ropes of aloes, 5·30 m. × 0·21 m. × ·03 m. Life, 3½ years.

Cost:	Frs. per sq. m.
Material	8·00
Laying	·30
Special nails, 4 kgs. at ·50 fr.	2·00
Total	10·30

4. Paving with blocks Karri wood, ·10 m. thick. Life, 5½ years.

Cost:	Frs. per sq. m.
Timber (including sawing)	16·00
Laying	1·00
Dry sand	·20
Layer of asphalt under blocks	3·00
5 kgs. of bitumen at ·40 fr.	2·00
Laying	1·00
Total	23·20

An economical coefficient of the various surfacing of movable bridges can be deduced from these figures after modifying them by the life.

In this way we find the actual cost of planking in white wood or northern pine amounts to 8·58 frs., whilst Jarrah planking cost 7·63 frs.; surfacing on aloes ropes, 4·18 frs., and Karri paving, 4·18 frs.

From these figures it is clear that the superiority of a road surface on aloes ropes and of Karri paving for intense traffic is undoubted.

Messrs. Denil and Bijls intend to carry out experiments with a surfacing of asphalted ropes. They are sanguine of producing an ideal surface for movable and suspension bridges, having a life equal to that of Karri blocks, at considerably less cost.

Sheet Asphalt.

Sheet asphalt.

Sheet asphalt surfaces for bridges are employed largely in the States with varying success. It is frequently laid on steel troughing, the spaces between the troughs being filled with a bituminous concrete. It is also laid on wood planking.

In France asphalt is usually laid in the shape of a layer 5 centimetres in depth on a concrete foundation of 15 centimetres. Mr. Verrière says it is seldom used for bridges as it becomes too slippery on gradients exceeding 1·5 centimetres per metre.

The weight is about 100 kilos the square metre, and its price about 17 francs per square metre.

Occasionally hydraulically compressed asphalt sets are used. The sets are closely packed, and the slight interstices are filled in with powdered cement.

This paving has the advantage of being extremely simple to lay, as it does not require skilled labour, and can be repaired most easily. The price of a square metre of surfacing costs, at the factory, from 5 frs. to 5 frs. 50 c. The laying of the setts costs about 3 frs. 50 c.

The chief drawback to asphalt is its slipperiness on steep gradients, and it is unsatisfactory along tramway rails, or where there is considerable vibration in the bridge floor.

Stone Setts and Macadam.

Stone setts and macadam.

Macadam and stone setts are excessively heavy; macadam 8 inches deep weighs 80 lbs. per square foot, and stone setts 8·6 inches deep on ordinary foundations weigh 120 lbs. to 140 lbs. per square foot. Either may be used to advantage on massive bridges of stone, brickwork, or concrete. The irregularities in stone block pavement cause shocks which may cause dangerous oscillations in iron bridges, and it is noisy, especially on such structures. These defects are reduced to some extent by a sand cushion.

Mr. Verrière, who has written an excellent paper on this subject, says:—
"Tramway lines on a bridge affect the choice of surfacing. Alongside
" tramway rails macadam is quite unsuitable, and asphalt is hard to main-
" tain. If asphalt is used, is should be separated from the rails by a strip
" of stone setts or wood-paving. To give elasticity and reduce vibrations
" on bridges tramway rails are sometimes bedded on felt, lead, or leather,
" and sometimes on an inch of asphalt. The method adopted at Lyons of
" bolting the rails to creosote wooden stringers set in concrete has given
" excellent results, and appears to be the best."

Mr. Verrière's conclusions are—

1. On movable and suspension bridges, the choice is confined to timber or cable surfacing, and the latter is cheaper and more durable. Mr. Verriere's conclusions *re* Surfacing for bridges.
2. For other bridges, which can only carry medium weights, the choice lies between—(*a*) compressed asphalt, in continuous slabs or in blocks, where there are no tramways and the gradients are slight, and (*b*) wood-paving, which can be laid against tramway rails and on steep slopes. Pitch jointing is desirable for wood-paving on bridges to lessen trouble from expansion and secure water-tightness. In certain cases reinforced concrete slabs afford an excellent light foundation for wood-paving.
3. On massive bridges, macadam, or preferably stone paving, is most suitable, especially in the open country, where skilled labour is not always easily obtainable.
4. The choice of surfacing on Country bridges should be of a kind unlikely to require frequent attention by skilled workmen.

2nd Question.—Resolutions adopted by the Congress.

1. The choice of road-surfacing for bridges depends on the nature and intensity of the traffic, the local conditions, such as permissible first cost, kinds of material readily available, and climate. For light bridges the choice is largely influenced by the weight of the surfacing. Public safety and convenience should be first regarded rather than questions of comparative cost. Resolutions passed by the Congress.

2. On short bridges in town or country it is desirable that the surfacing should be the same as that on the adjoining streets or roads.

3. In forming the roadway on bridges, special care should be taken to secure proper drainage and to prevent the harmful percolation of water with longitudinal gradients of at least 1 in 50, the cross-section of the surface made be made nearly flat, and the dead load thus reduced.

4. As a general rule, the surfacing of a bridge should be waterproof, capable of resistance to wear, durable, and of a weight appropriate to the structure of the bridge: it should also be as smooth as possible without being slippery.

5. Plank surfacing on bridges is light, and its first cost is low. Its cost of maintenance is, however, excessive, except where the traffic is light. Its extreme liability to damage by fire is a serious disadvantage. It should not be adapted except in remote districts in which there is an abundance of cheap timber, and where a more desirable form of surfacing is not easily obtainable. Single plank floors are only suitable for very light traffic. For moderate or heavy traffic two layers of planking, the lower of which is creosoted or otherwise protected from decay, should be used.

6. Macadam, or ordinary broken stone surfacing, on timber planking, is not always satisfactory on account of its great weight and its permeability. Macadam is, however, quite satisfactory for massive bridges in rural districts, if the substructure has a proper damp-proof course.

7. Macadam, bound with tar, or other waterproof and elastic material, is useful and economical for the surfacing of rural bridges with moderate traffic, when the spans are short or the structure is massive.

8. Wood-block paving, 3 to 5 inches thick, is an ideal surfacing for bridges in most cases. It is light and durable and can be laid on concrete, or, when weight must be minimised, on a timber subfloor, which should be creosoted. Special care should be taken in the selection, treatment, and laying of wood blocks for bridge paving, to avoid troubles due to expansion and contraction of the blocks or of the metal structure.

9. Asphalt, in various forms, is an excellent surfacing material for bridges with easy gradients, on which the traffic is not confined to definite lines, or very heavy.

10. Stone paving, carried out with ordinary hand-dressed setts or with small setts (Durax, Kleinpflaster) laid on concrete and bound with cement or pitch, makes excellent and economical surfacings for bridges with heavy traffic. However, it is only suitable in cases where questions of weight of the surfacing or of noise are of no importance. The thickness of the layer of sand interposed between the sets and the foundation will be decided in the same way as with an ordinary carriageway in town or country, as the case may be.

11. For movable bridges, and for non-rigid suspension bridges, the surfacing should be light and easy to attach to the bridge platform. The trials made in France and Belgium with old mine cables, or other fibrous substances of even less cost, and with such materials impregnated with tarry, bituminous, or asphaltic materials, should be encouraged.

CONSTRUCTION OF MACADAMISED ROADS BOUND WITH TARRY, BITUMINOUS, OR ASPHALTIC MATERIALS.

Twelve reports on this important question were submitted to the Congress.

General Reporter. Mr. J. Walker Smith, M.I.C.E., F.S.I., Chief Engineer to the Local Govt. Board (Scotland).

The question put was :—Which are the best materials for the construction in open country of macadamised roads bound with tarry, bituminous, or asphaltic materials ?

It was desired that reports sent in upon this general question should include specific comment upon all or some of the following sub-heads, viz. :—

1. Foundations and drainage.
2. Sizes and shapes of broken stone for bituminous bound surface crust.
3. Use of partially worn materials in bituminous bound surface crust.
4. Thickness and composition of the strength crust and of the super or wearing crust under different conditions.
5. Life of surface crust under different conditions of traffic, weather, subsoil, &c.
6. Relative importance of patching, repairs, and periodical renewals of wearing crust.
7. Extent of wear permissible before renewal of surface coating.
8. Measurement of wear, and appliances used for this purpose.

Various methods of bituminous treatment.

9. Various methods of bituminous treatment—
   - (*a*) Mixing methods—
     - (1) in factories;
     - (2) on the spot.
   - (*b*) Grouting methods.
   - (*c*) Carpeting methods.
   - (*d*) Other methods.
10. Relative advantages and use of tar, tarry compounds, asphalt, and other materials.
11. Tests and chemical analysis of tarry, bituminous, and asphaltic compounds.
12. Climatic effects causing slipperiness of the roadway—remedies.
13. Effect on public health, fish life, or vegetation.
14. Specification of the methods of construction.
15. Cost data.
16. Cleansing and watering.

1. Foundations and Drainage.

Foundations and drainage.

There is general consensus of opinion regarding the vital importance of good foundations and efficient drainage. The British reporters point out the necessity for good drainage of sub-soil by open jointed pipes, side ditches, or other generally accepted methods.

They recommend the interposition of a layer of ashes or sand between a clayey sub-soil and the foundation.

In Germany it has been settled that a solid foundation, 8 ins. thick, is absolutely necessary. The Swiss reporters state that the important question of foundations does not receive the attention it deserves.

In India, perhaps from the fact that a plentiful supply of excellent stone is available in most districts, and that labour is cheap, the road foundations are for the most part excellent, better in fact than are usually found on the continents of Europe and America. The use of wedged-shaped blocks with a square base, laid with the base resting on the rolled foundation affords a splendid means of distributing the load, and when compacted with the overlaying great thickness of road metal, proves a very strong road indeed. For roads where traffic is light and formation good, this heavy Telford foundation may be omitted, provided there is an ample thickness of metal road beneath the wearing crust.

2. Sizes and Shapes of Broken Stone for Bituminous bound Surface Crust.

Sizes and shapes of broken stone for surface crust of bituminous bound surface crust.

In America it is considered that, for the purpose of tar macadam, stone larger than 2 ins. should be used with caution in the construction of the upper crust, unless the voids are properly reduced, because of the liability of the individual stones to rock under traffic.

When dealing with the grouting method, it is considered that a larger stone may be used with advantage, and a stone passing a $2\frac{1}{2}$-in. ring and retained upon a $1\frac{1}{2}$-in. is preferred. It is thought that more uniformity of grouting together with longer wear are secured by the use of larger stones within limits, and subject to the stone being broken *cubical* and having sharp angles, and that the larger stones are better able to withstand crushing under heavy loads carried upon steel tyres.

In England, stones of 2 ins. to $2\frac{1}{2}$ ins. closed with $\frac{1}{2}$ in. or $\frac{3}{4}$ in. stones is thought to give the best results for the grouting method.

In Hungary, stone broken to three or four grades is used for the surface crust on the principle that the roads are more completely filled by this method. The use of river-stone is strongly deprecated owing to the smoothness of the surface and the heterogeneous geological combination.

In Switzerland, the engineers used stone broken to a somewhat smaller gauge than is the practise in England and America.

3. Use of partially-worn Materials on Bituminous bound Surface Crust.

Use of partially-worn materials in bituminous bound surface crust.

This, apparently, is not thought to be a question of vital importance.

4. Thickness and Composition of the Strength Crust and of the Super or Wearing Crust under different Conditions.

Thickness and composition of the strength crust and of the super or wearing crust under different conditions.

The thickness of the strength crust and the wearing surface are governed by the conditions of the road, sub-soil, position, gradients, volume and character of traffic, and other factors, and it is therefore impossible to lay down hard-and-fast rules. The Road Board are conducting experiments at Sidcup, in Kent, and other places, and reference is made to the first report of the Advisory Committee of the Board upon trial lengths of various forms of construction near London (copy of report annexed). This report contains much valuable information, and as I made an inspection on foot of all the trial lengths, I can vouch for the thoroughness with which the tests are being carried out.

In Germany it has been found that for surface tarring and tar macadam harder stones like basalt have proved more suitable than softer kinds like limestone. The one advantage of the softer stone is that tar and tar products cling better and are more readily absorbed.

5. Life of Surface Crust under Different Conditions of Traffic, Weather, Sub-soil, &c.

Life of surface crust

Here, again, there are many factors—local, physical, climatic, and traffic—which militate against setting up a standard.

under different conditions of traffic, weather, subsoil, &c.

The author of one of the reports from France states that ordinary macadam is increased in life, sometimes 50 per cent., and often more, by surface tar treatment. A German reporter opines that motor traffic actually improves roads laid with bituminous macadam, as the car wheels help to compress the surface crust.

The Swiss reporters refer to the damage done to roads by frost and thaws and variations in temperature, but consider varying climatic conditions as far less harmful to bituminous-bound roads than to those of ordinary macadam.

Relative importance of patching, repairs, and periodical renewals of crust.

6. Relative Importance of Patching, Repairs, and Periodical Renewals of Crust.

Frequent patching and the "stitch in time" principle is universally advocated on the score of economy and efficiency.

Extent of wear permissible before renewal of surface coating.

7. Extent of Wear permissible before Renewal of Surface Coating.

The answer to No. 6 applies to this.

8. Measurement of Wear and Appliances used for this Purpose.

Measurement of wear and tear and appliances used for this purpose.

Not much work of this character has been done. In Switzerland the wear is measured by taking cross-sections and by prickings.

The German reporter refers to the difficulty of differentiating between what is due to actual wear and how much to compression when based on measurements taken with a level. It is suggested that accurate measurements may be made by the amount of dust produced by the traffic, but this would be difficult in practice, and there are many factors which might vitiate the result. There are several reliable instruments for measuring the wear of roads, of which there are three at least in England, designed by Mr. J. A. Brodie, Colonel Crompton, and Mr. Maybury.

9. Various Methods of Bituminous Treatment.

Various methods of bituminous treatment.

(*a*) Mixing methods—
  1. in factories;
  2. on the spot.
(*b*) Grouting methods.
(*c*) Carpeting methods.
(*d*) Other methods.

Hand-mixing, which was in vogue generally up to about two years ago, is now rapidly giving place to mechanical mixing, either in suitable depôts or in portable plant at the roadside.

It is impossible, even in an abridged form, to describe the various methods of bituminous treatment. There are close upon a hundred methods, and very naturally there will be no general agreement as to which is the best. As the General Reporter says:—"Some pin their faith to the surface tarring "of water-bound macadam; some can find no good in the grouting method "and greatly prefer the mixing method; some prefer the grouting to the "mixing method; some find tar compounds the best binders, and others "advocate natural asphalts; some prefer limestone and others hard stone; "some prefer mixing at a depôt and others at the road-side. It is quite "evident that there is no one best method, but various methods and materials "are right and best under certain conditions; but it appears to make for "sound economy to aim at perfecting methods which enable the maximum "use to be made of the materials at hand, particularly in using the stone of "the county."

10. Relative Advantages and Use of Tar, Tarry Compounds, Asphalt, Bitumen, and other Materials.

Relative advantages and use of tar,

It is pointed out that there is insufficient reliable data to correctly estimate the relative advantages of binders. On roads where traffic is light, surface tarring at a cost of £50 per annum per mile is giving excellent

results in preventing dust and prolonging the life of the road. Where traffic is heavier the more expensive interior treatment, either in tar macadam or in grouting, with pitch, oils, and sand is employed with satisfactory results. In America unrefined tars have been abandoned for use in the penetrative method. Both in Egypt and Greece remarkable results have been obtained by mixing asphalt with lead slag; the roads have stood up to the heaviest traffic for long periods without showing any signs of wear, and it would almost appear that in the admixture an ideal road surface had been discovered.

Tarry compounds, asphalt, bitumen, and other materials.

11. Tests and Chemical Analysis of Tarry, Bituminous, and Asphaltic Compounds.

Standardisation of specifications.

It has been demonstrated that the success of tar-bound road work depends upon the chemical composition of the tar. Specifications have been drawn up by America, Great Britain, and Germany, and it is agreed that the greatest advantage would accrue from adopting principles and methods in common and in prearranging a system of record.

Professor Torri (Italy), in his paper on the chemistry of tars, bitumens, &c., laments our limited knowledge of the chemistry of asphalt, and remarks that we shall need to make real progress by the correlation of laboratory tests with the behaviour of the materials under service conditions. The complex and varying nature of the bituminous road materials is already recognised by the leading highway engineers, and as a logical sequence they recognise the necessity for systematic testing and analysis. The General Reporter for this question observes that "in due course standard specifications " and standard methods will be required for all recognised road binders, " including not only tar and asphalt, but petroleum residuals, mixtures of " tar with petroleum residuals, or asphalt, and other combinations"; and he suggests that "steps should be taken to standardise the requirements of " tar and asphalt which up to the present are the binders by far the most " used."

Analysis for tar and asphalt.

The recognised analyses usually include—

For Asphalt.	For Tar.
Specific Gravity.	Specific Gravity.
Viscosity.	Freedom from water and ammoniacal liquors.
Penetration.	Phenol bodies.
Melting Point.	Naphthalene.
Flash Point.	Free Carbon.
Volatilisation.	Fractional Distillation.
Total Bitumen.	Volatilisation.
Fixed Carbon.	Penetration.

Road Board Specification for tarring of roads.

A copy of the Road Board General Directions and Specifications relating to the Tar Treatment of Roads is annexed to the report.

This document, which is worded in simple language, and free from abstruse technicalities, should be of the greatest use to engineers and others engaged in the work of road construction and maintenance.

12. Climatic Effects causing Slipperiness of the Roadway—Remedies.

Climatic effects causing slipperiness of the roadway.

It appears to be generally known that most smooth and waterproof surfaces may become slippery under certain conditions of weather.

A good cleansing of the surface and sprinkling with coarse sharp sand usually prevents the carriageway becoming slippery.

13. Effect on Public Health, Fish Life, or Vegetation.

Effect on public health, fish life, or vegetation.

The opinion seems to be pretty general, in Britain at any rate, that benefit to health accrues from the tarring of roads, and this is endorsed by Medical Officers of Health. Hygienically it is an advantage on account of

the diminution in dust and mud. Dust from tar or pitch is more pungent and irritating to the eyes than ordinary dust, but there is so much less of it. Tar has germicidal and disinfecting qualities. No complaints have been substantiated as to fish life having been affected, but opinion seems to be divided as to the effect of tar on vegetation. It is now common knowledge that there results a considerable diminution of dust by the use of bituminous binders.

Possible disadvantages of tarred roads.

The possible disadvantages may be summarised thus:—

(*a*) Tendency to injure roadside trees by water-proofing the surface too close around the hole.

(*b*) Unpleasant odour during operation, and subsequently from certain volatile oils during warm weather.

(*c*) Danger to fish life if ammonia and phenols are not reasonably excluded.

(*d*) The non-absorbent surface leaves manure and vegetable debris free play.

(*e*) Dust produced from tar and asphalt surfaces is more irritating to eyes, nostrils, throat, and skin.

Remarks by General Reporter.

Considering the disadvantages submitted "it is obvious," says the General Reporter, "that there is very little serious objection to be raised."

(*a*) The soil around the trees should not, and certainly need not, be waterproofed by tar to the detriment of the roots.

(*b*) The odour at times of application—if objectionable—is certainly of short duration, and the subsequent odour from volatile oils is only occasional and of gradually declining severity.

(*c*) The danger to fish life can be and should be positively averted.

(*d*) The particles of manure and vegetable debris will be somewhat heavier from contact with tarred surfaces, but the surface drying more quickly and offering less frictional resistance may allow the dust to rise more readily under the influence of wind.

(*e*) The additionally irritating nature of the dust is more than compensated for by its reduction in amount, and by the selection of low carbon tar can be considerably reduced.

11. Specification of the Methods of Construction.

Specification of methods of construction.

A very large number of specifications are submitted or referred to by the authors of the different reports, but it is not possible to find space for them in this report. By degrees, as methods are standardised, specifications will be simplified. The Permanent Association in Paris is engaged in collecting and collating a vast amount of data drawn from many countries, and by degrees we may hope for the elimination of much in the way of materials and construction that time and experience have found to be faulty. The field of work is now well defined and success will only result from methodical and persevering work.

15. Cost Data.

Cost data.

It would be of very little use to go into matters of cost at any great length as there are so many varying factors to be taken into consideration. The first cost is not necessarily of the greatest importance. The cost of reconstruction or resurfacing, and the periods between the resurfacing operations, and the cost of maintenance during these periods, are the important factors from which the cost per ton carried may be deduced.

In Great Britain surface tarring varies from two thirds of a penny per square yard for crude tar, obtained locally in county districts where wages are low, to 1½ pence and 2 pence where distilled tar is used and prices generally are higher.

Surfaces laid with tarred or bituminously mixed macadam vary in proportion to the cost of the stone or slag, which may be anything between 5*s.* and 15*s.* a ton. Where the lower prices obtain, tarred surfaces consolidated to 3 ins. have been laid for 1*s.* 9*d.* per square yard, whereas the higher priced materials have caused it to rise to 3*s.* and 3*s.* 6*d.* Where

pitch-grouted methods have been adopted the prices vary from 2*s*. 6*d*. to 5*s*. per square yard 3 ins. thick. In Liverpool the present cost is 1*s*. per square yard per inch of thickness.

The approximate price per ton for mechanically heating and mixing macadam with tar or tarry compounds lies between 4*s*. 6*d*. and 7*s*., according to the matrix used, distance from stations, &c.

16. Cleansing and Watering.

Cleansing and watering.

Opinion is unanimous that considerable economies are effected both in scavenging and watering by the use of bituminous or asphaltic materials for the road surface.

3rd Question.—Resolutions adopted by the Congress.

Resolutions adopted by the Congress.

By the use of bituminous, including tarring or asphaltic binders, we may obtain a number of different forms of road crust, which may be employed with advantage, according to the various conditions of the road as regards traffic, locality, and climate.

The exact value and duration of life of these various road crusts, taking into account traffic, climatic conditions, and the methods of construction, remain to be determined.

For this purpose it is advisable to draw up a uniform system of tests, measurements, and records, under the following headings:—

1. Physical and local conditions. (Plans, cross-sections, slopes, camber, foundations, sub-soil.)
2. Materials employed, petrological analysis, dimensions, composition of the binding agent.

2*a*. Method of construction, date of construction.

3. Census of traffic on the section under review.
4. Climatic conditions affecting the road.
5. Periodical measurement of wear.
6. Periodical examination of the state of the road crust.
7. Actual cost of the road crust—(*a*) as regards cost of construction; (*b*) as regards maintenance cost.

The standard form, in which the information is to be furnished, will be drawn up by the Permanent Commission.

Particular Conclusions.

I.—*Foundation and Drainage.*

Particular conclusions.

Confirming the conclusions adopted in 1910 by the 2nd Congress (Brussels), Question 2, which called attention to the advantages of a dry foundation and a sound sub-soil, the Congress especially insists upon the great importance of efficient foundations in the case of road crusts bound with bituminous (including tarry or asphaltic binders) for the following reasons:—

(1) The road crust being expensive, it is important to give it a base which will increase its life.

(2) As the weight, speed, and intensity of the traffic continually tend to increase on roads considered worthy of such a crust, it is best to provide a foundation which has been so constructed as to secure for the crust the best possible conditions of resistance to wear.

II.—*Dimensions and Shape of Metalling.*

1. When an ordinary macadamised road crust is constructed with a view to being tar-sprayed, it should be constructed of hard metal, with sharp edges, and broken as nearly as possible to a cube of the dimensions of from 4 to 6 cm.

2. In the case of bituminous, including tarry or asphaltic macadam, carried out by the mixing process, the dimensions of the metal may be so selected and graded as to form a compact road crust with the fewest possible voids.

The dimensions of the largest metal may vary according to the nature of the stone and of the traffic. When the process of construction employed requires more than one layer of material, the upper layer or wearing crust may be formed of smaller metal.

3. In respect of bituminous, including tarry or asphaltic road crusts constructed by the penetration process, the trials and tests now being carried out in various countries should be continued, taking care only to employ metal of as cubical a shape as possible, and with sharp edges, at any rate, for the portion of the road crust nearest the surface.

4. It is understood that further experiments will also be carried out in the use of other methods, and especially those referred to in paragraphs (1) and (2).

III.—*Employment of partially used Metal.*

By carefully eliminating all particles of mud and organic matter, it is possible to successfully make use of partially worn materials, on condition that they are not employed for the surface of the road crust.

IV.—*Relative importance of Patching.*

It is agreed that it is absolutely necessary to carry out repairs, in the case of all bituminous, including tarry and asphaltic road crusts, immediately the necessity for them arises.

V.—*Permissible Wear.*

The complete renewal rendered necessary by wear and tear must be carried out immediately the depth of the road crust is below a given limit of safety, or when its waterproofing qualities have become so poor that the road will unduly suffer from climatic conditions.

VI.—*Various Means of employing Tarry, Bituminous, and Asphaltic Materials.*

In using these materials, both in the penetration method and the mixing method—

(*a*) It is preferable to use dry stone in order that it may adhere well to the binder. In the mixing method the stone must be dry, and, if necessary, it must be heated.

(*b*) One must never lay a top crust upon a soft or damp foundation. One should preferably carry out the work in fine weather.

(*c*) One must never employ too much binder, but only a sufficient quantity to bind the portion of the road which is being rolled.

(*d*) One must never employ road rollers which are too heavy.

VII.—*Tests and Chemical Analysis.*

The advantage of analyses and methodical laboratory tests, and their necessity in the case of bituminous binders, are unanimously recognised.

It would be of advantage to obtain uniformity—

(1) As regards the specification of the principal characteristics of these binders.

(2) As regards the methods of testing for drawing up these specifications. The Permanent International Commission will be entrusted with the work of inquiring into the best way of standardising the above.

VIII.—*Climatic Effects.*

It appears to be generally agreed that certain tarry, bituminous, or asphaltic road crusts (as is also usually the case with all smooth and waterproof surfaces) may become slippery under certain conditions of

weather. This may be remedied by strewing the surface with coarse sharp sand; and, in most cases, a good cleansing of the surface will usually prevent the carriageway becoming slippery.

IX.—*Effects on Public Health, &c.*

Sufficient information is now available to enable engineers to select and specify bituminous binders which will have no prejudicial effect upon public health, fish life, or vegetation; but which, on the contrary, will conduce to conditions of considerable hygienic advantage.

X.—*Cleansing and Watering.*

It is recognised that carriageways properly treated with bituminous, including tarry or asphaltic materials, require less sweeping and watering that ordinary water-bound macadamised roads, and that they allow of considerable economy being effected under this head.

The meeting puts forward the following additional proposal:—

> That an International Technical Committee should be appointed by the Permanent International Commission, in order to study a standard method of obtaining information and data upon materials, physical conditions, local conditions, methods of construction, terminology, and other points concerning macadam bound with tarry bituminous or asphaltic binders.

The report of the Committee should, after examination of the Permanent Committee, be presented to the next Congress.

It will be seen that in the Directions and Specifications drawn up by the Road Board relating to the Tar Treatment of Roads, no detailed information is given concerning the many bituminous and other proprietary compounds on the market used in connection with the construction and maintenance of roads.

As there are so many of these proprietary compounds on the market in different countries it is not possible to describe them all at length, but it is thought that this report would not be complete without reference to some of the more important of them.

"Tarmac," which is one of the best known road materials, is made of blast-furnace slag, specially selected for the purpose. The Company's works are at Wolverhampton, adjacent to the furnaces of Messrs. Alfred Hickman, Ltd., and the Dudley Iron and Coal Company, Ltd., respectively. Tarmac

The Company have a fully equipped tar distillation plant at their works, and the tar compound used for coating is distilled and prepared to physical and chemical standards known to give the best results as regards strength of binding properties, freedom from tendency to affectation by atmospheric variations and length of life as an effective binder.

The slag has an exceptionally rough surface which gives it great holding power for the mixture used for coating. It is said to be porous enough to retain and hold the mixture, and is at the same time as strong as the best classes of granite and similar materials. "Tarmac" is made in three gauges—

2½ ins.	(containing pieces from	2¾ ins.	down to	1½ ins.)	
1½ ins.	(„	„	1½ ins.	„	⅜ in.)
⅜ in.	(„	„	⅜ in.	„	⅛ in.)

The material is sent out from the works in the Company's own trucks ready for immediate use.

The Company have Two Standard Specifications—No. 1 providing for the use of 2½ ins., 1½ ins., and ⅜ in. gauges; No. 2 providing for the use of 2½ ins. and ⅜ in. gauges only.

No. 1 Specification: "Tarmac" should be applied in two layers, bottom layer consisting of 2½ ins. gauge, top layer of 1½ ins. gauge; each layer should be separately consolidated with a roller of about 8 to 10 tons in weight.

The surface of the top layer, after half consolidation, should be well sprinkled with ⅜ in. material, so as to fill all the interstices, and again rolled to complete consolidation and give an even and watertight surface, being

afterwards blended with slag or other suitable grit at the rate of 1 ton to every 250 square yards of road surface.

The thicknesses of each coat for this specification are as follows:—

Surface 4½ ins. thick, bottom coat 2½ ins. thick, top coat 2 ins. thick.
„ 4 ins. „ „ 2½ ins. „ „ 1½ ins. „
„ 3 ins. „ „ 2 ins. „ „ 1 in. „

"Tarmac" has been largely used all over England with excellent results.

The Road Board have laid down experimental lengths at Sidcup and Wandsworth, a description of which will be found in the interim report of trials of road materials annexed to this report.

Some years ago I obtained particulars from the Company with a view to giving "Tarmac" a trial in Bombay, but the cost was prohibitive, and the matter had to be dropped.

"CAMARCO" ROAD ASPHALT.

Camarco. "Camarco" has recently been introduced into Britain by the Canadian Mineral Rubber Company, Limited.

Its basic material is Gilsonite, said to be the purest form of natural bitumen known.

It may be used as a grouting, but better results are obtained by mixing it with the stone in the form of a concrete, using hot aggregate, graded or ungraded.

It is advisable to do the mixing with a machine mixer, as economy is effected thereby, the concrete is absolutely uniform, and the minimum of bitumen is used.

In using it for carpeting a road the mixture is made with a small aggregate, graded from quarter inch down to limestone dust. The resulting mastic is laid on the road surface to a depth of 2 ins., consolidated by a light roller, and the surface is ready for traffic.

"Camarco" is comparatively new to England so it would be premature to say very much about it. It appears to have given satisfaction to several borough engineers and surveyors in England.

"ROADOLEUM" ASPHALT.

Roadoleum. Roadoleum is a pure bituminous asphalt product marketed by the Anglo-American Oil Company. It has not been used to any great extent in the British Isles, and judging from the result of the trial length at Sidcup, laid down for the Road Board, it does not appear to have been very satisfactory. This may have been due to carelessness in supervision rather than any inherent defect in the binder, but its entire failure has not enhanced its reputation, and engineers will be chary about giving it a trial.

"PITCHMAC."

Pitchmac. "Pitchmac" is a bituminous mixture manufactured by Taroads Syndicate, Ltd., 9, Victoria Street, Westminster.

The section at Sidcup made of this material is said to have been quite one of the best, and reference to it is invited in the interim report. The price is perhaps rather high, but the material appears to be very durable, and in Liverpool, where many miles of road have been treated with it, the result has been entirely satisfactory.

In the introduction to their booklet the proprietors of "Pitchmac," say: "In the City of Liverpool, where the traffic is exceptionally heavy, " not only in the total tonnage per yard super per annum, but also the " total axle load per vehicle, very careful experiments have been carried " out, and the results observed and analysed with a view of producing a " form of road pavement capable of withstanding modern traffic conditions. " These tests, which commenced some 13 years ago, have resulted in " producing a practically permanent road pavement capable of with- " standing modern road traffic, known as Brodie's Liverpool System of " Road Construction."

Mr. Brodie, it will be remembered, was one of the trio of experts deputed to come out to Delhi and report on a suitable site for the new Imperial capital.

The system of "double pitch grouting," Colonel Crompton remarks, "gives, undoubtedly, one of the strongest roads than can be produced with pitch."

TRINIDAD ASPHALT MACADAM.

Trinidad Lake Asphalt.

Sections 22 and 23 at Sidcup are constructed of this material, and the reports thereon speak for themselves. Colonel Crompton, the Consulting Engineer to the Road Board, has great faith in this system. He considers that the problem before engineers is to produce a sheet pavement resembling asphalt, but at a fraction of its cost. He says: "The gradual introduction of "methods of covering our roads with a satisfactory and smooth running "wearing coat or carpet of sand or other siliceous matter bound by pitch or "bitumen at a cost which can be borne by the ratepayers is only a question "of engineering study, of the use of suitable machinery and suitable methods "of rolling, and of the organisation of staff and workmen."

FLUXPHALTE AND MEXPHALTE.

Fluxphalte.

These products are petroleum residuals manufactured by the Anglo-Mexican Petroleum Products Co., Ltd. Fluxphalte, which is a liquid, contains over 65 per cent. of pure bitumen, and has been most successfully used as a substitute for ordinary tar for road spraying. I inspected long lengths of road treated with Fluxphalte in close proximity to other lengths treated with ordinary tar. They were treated at the same time and were subject to the same traffic, so that a reliable opinion could be formed of their respective merits. The cost was the same. The results were all in favour of the proprietary compound, which was in as good a condition at the time of inspection as when first laid down, whereas the tar-sprayed lengths were peeling badly and would shortly require renewal. The function of the dressing of Fluxphalte is to prevent the dust which occurs on an ordinary water-bound macadam road, and to strengthen the crust by forming a waterproof binding surface.

Fluxphalte requires to be heated before it is applied to the road to a temperature of at least 250° Fahr. The best results are obtained by a spraying machine having an air pressure of from 80 to 100 lbs. per square inch. The most successful results are obtained with a type of nozzle which atomises the dressing and applies it in a fine spray rather than in a continuous sheet or stream.

The dressing should be followed by a liberal sprinkling of sand or small chipping. One gallon of Fluxphalte covers about four square yards.

Mexphalte.

Mexphalte is a solid bitumen, practically 100 per cent. pure. It has a high cementing value as a road binder, possessing great ductility. It is said to possess great stability, *i.e.*, it does not contain light and volatile oils which evaporate on exposure to air or high temperatures, leaving the bitumen very brittle.

Definition of asphalt.

It may be explained here that "asphalt" and "bitumen" are almost synonymous terms in the United States. It is preferable, however, for the word "asphalt" to be generally accepted as indicating a "composition" of various materials in which bitumen is the cementing mastic. Many excellent stretches of road have been laid with mexphalte in London and the provinces, all of which have to stand very severe traffic conditions. It has also been largely used on the Continent of Europe and in America.

For pavements, courts, playgrounds, footpaths, station platforms, and other purposes, a very serviceable asphalt can be made from mexphalte in the following proportions:—

Sand - - - -	80 per cent.
Dust - - - -	10 „
Mexphalte - - -	10 „

This asphalt, compressed, weighs about 200 lbs. per square yard two inches thick.

NATURAL ASPHALT MATRIX.

This binder, which is marketed by the Val de Travers Asphalt Paving Co., Ltd., is composed of Trinidad Lake bitumen and natural rock asphalt (*see* Section 20, Report of Road Board Trials at Sidcup). The metal is first laid to a depth of three inches and rolled to proper levels and contours. The matrix, heated to about 375° Fahr., is then run into pails and quickly poured over the metal, filling the interstices level with the surface. The surface is then liberally covered with granite chippings.

Before the binder has cooled a steam-roller is passed two or three times over the section thus laid, this being the final consolidation. Shortly afterwards the roadway can be opened for traffic.

The use of 2-inch gauge metal is recommended.

The price of natural asphalt matrix, I am informed, would be about £3 per ton, f.o.b., London, barrels free.

The covering capacity of this material is about 30 yards to the ton, when the metal is 2½ ins. thick after consolidation.

4th Question.—Wood-paving.

Section I, Subsection B. — General Reporter, H. P. Boulnois, Esq., M.I.C.E., London. General.

It was not possible for me to attend in person the meetings of the Congress in this and the succeeding questions; my remarks are therefore based on a perusal of the reports submitted by various authors for consideration by the Congress.

The question as to where and under what conditions of traffic wood-paving is the most suitable form of road surface does not appear to have been definitely answered, as so much depends on local circumstances.

Choice of Woods.

Choice of woods.

The different classes of timber which experience has shown to be the most suitable are as follows:—

(1) Fir or Pine, including Baltic, St. Petersburg, or Archangel Deals.

(2) Hard woods, of which Australian Jarrah is the principal representative. Other timbers have been used from time to time less successfully, viz., Pitch Pine, Beech, Oak, Blue Gum, Tallowwood, Spruce, and Larch.

Soft woods.

The timber most largely in use in recent years is undoubtedly the Fir or Pine in some of its varieties. Baltic timber varies a very great deal in character, and on this account it requires careful selection. Archangel timber is usually much more even in grain, though, being softer wood, it has not the life under traffic of the heavier timber from the Baltic.

The blocks are usually 5 ins. in depth, cut from 3 ft. × 9 ft. deals.

Hard woods.

Australian Hard woods have been extensively used during the last 20 years for wood-paving in England, but latterly they appear to have lost favour with some Road Authorities. These woods are very hard and dense in character, of good uniform quality, and entirely free from Sapwood, and in these respects have important advantages over Fir and Pine as regards their suitability for street-paving purposes. They have a life of from 10 to 15 years under the heaviest London traffic.

The chief objection which has been made to this class of paving is the trouble which arises from the expansion and contraction of the blocks, especially the latter.

The fibre at the edges of the blocks being hard and brittle, the arrises are worn away by the shoes of horses, and the surface of the road assumes a corrugated appearance.

In recent years, to meet the objections which have been made in connection with the use of solid Jarrah and Karri blocks for street paving, a sectional block has been introduced which is built up of four to six pieces secured together on the underside of the block by two tongues of Jarrah wood fixed obliquely in the block, which permits the full depth to be available so far as practicable for wear. By this means of allowing for

expansion, the chief defect in connection with the hard wood block is overcome. The blocks are usually made 3 ins. × 9 ins. × 3 ins. in depth, and in some cases 3¼ ins. in depth.

Sectional block paving has been laid down at Hampstead with such excellent results that it has now been extended throughout the whole length of Edgware Road in the Hampstead district.

The conclusion forced on one by an examination of the facts is, therefore, that if hard woods such as Jarrah can be laid, jointed, and maintained so as to be waterproof in all respects, they possess an important advantage over deal as a sanitary and durable paving material.

Creosoting of Wood Blocks.

Creosoting of wood blocks.

At one time there was considerable diversity of opinion as to whether the extra life and other advantages conferred by the creosoting of wood blocks was commensurate with the increase in cost. Recent opinion, however, seems to be unanimous in favour of treating the blocks in some kind of preservative, especially in view of the sanitary advantages resulting from the process, especially when creosote is the preservative used.

Dr. Tidy, a well-known chemist, says: "The advantages to be derived "from the creosoting process are of a threefold nature: Firstly, a Physical "Action. A very greatly increased solidity is effected by choking up the "pores, thus agglutinating the whole mass of the wood into a more solid block.

"Apart from its rendering the wood more solid, the physical action is "important in preventing the subsequent absorption of moisture.

"Secondly, a Physiological Action. Creosote imparted to wood prevents "germinal life (well known to be destructive to timber) being developed "within it. Seeing that the preservation of timber has been effected by "such materials as chloride of zinc, sulphate of copper, &c., with greater "or less success, and that the action of these bodies must be mainly, "although not entirely, dependent on their toxic properties, this physiological "action is one of importance. It must be remembered, moreover, that "creosote has the advantage of a well-marked smell, which odour most of "the lower animals dislike. In this respect it is superior to the other bodies "named.

"Thirdly, a Chemical Action. Respecting the chemical action, tar acids "are not only antiseptic, but they possess the power of coagulating albumen. "This latter action plays a very important part in the preservation of the "timber."

Specification for creosote.

In an excellent paper on Wood-paving, presented by the Borough Engineers of Nottingham, Leicester, St. Pancras, and Hampstead, the following specification for creosote oil for use in connection with the creosoting of wood blocks is given: The creosote is to be of the description known as heavy oil of tar, obtained solely by the distillation of coal tar, and consist of that portion of the distillate which comes over between the temperature of 350° Fahr. and that of 760° Fahr.

The specific gravity shall be not less than 1·035, nor more than 1·065 at 60 Fahr., and, as nearly as possible, 1·050. The liquor must be free from any admixture with any oil or other substance not obtainable from such distillate: it shall contain not less than 20 nor more than 30 per cent. of constituents that do not distil over a temperature of 600° Fahr.

It must yield not less than 8 per cent. of tar acids. The creosoting liquor must become completely fluid when raised to a temperature of 100° Fahr. It is of the utmost importance that oil resulting only from the distillation of coal tar should be used; the oils resulting from the making of "Mond" or similar processes of power gas are absolutely useless for the preservation of timber.

The quantity of creosote oil which should be injected into Fir or Pine timber should be equal to not less than 10 lbs. per cubic foot of timber. There are several well-known processes for preserving timber, prominent among which are Bolton's and the more recently invented Powellising process. The absorptive power of different woods varies largely, being chiefly dependent on their density and structural composition. Thus Jarrah blocks absorb only about 4¼ lbs. of creosote per cubic foot; while deal blocks absorb as much as 17½ lbs. per cubic foot.

Laying of Wood Block Pavements.

Laying of wood block pavements.

Whatever kind of block is used, it is of the very greatest importance that the concrete foundation should be laid of sufficient strength to carry the traffic passing over the pavement.

This foundation should in no case be less than 6 inches excluding the thickness of the floating, and where traffic is heavy and the sub-soil poor it may have to be increased to as much as 12 inches.

On the concrete foundation should be laid a floating of not less than 1 in. in thickness composed of 1 cement to 2 or 3 of fine granite or sand. This should be brought to a perfectly smooth surface to the actual contour of the road, and when finished it should have a cross fall of about 1 in 36. The floating should be allowed seven days to harden before the paving is laid, or a bumpy pavement will result.

In wood block pavement it is necessary to make some provision for expansion, and this is usually done by leaving an expansion joint near the curb filled with bitumen, sand or clay, which will give when expansion takes place.

The width of the joint will depend on the width of the roadway, but, as a general rule, 1 in. to 1½ ins. is found to suffice.

The blocks should be laid in straight courses, at right angles to the curb, with the grain vertical to the concrete foundation. It was the custom up to a few years ago to pave the blocks close together in each course, grouting the surface of the pavement over with boiling tar or a mixture of creosote oil and pitch. With this method considerable displacement occurred, involving their being relaid. More recently the practice has been to allow from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. between the ends of the blocks, and also separating the courses by laths 1 in. deep and $\frac{1}{8}$ in. thick, laid on edge on the concrete foundation; the joints were thus maintained of an approximately uniform width, and only sufficiently wide to make it practicable to fill them with the grouting material.

Resistance to Wear.

Resistance to wear.

The following statistics give some particulars as to resistance to wear at Sheffield:—

Name of Street.	Class of Wood.	Laid.	Taken up.	Years' Wear Approx.	Original Depth.	Depth when taken up.	Wear.
					Ins.	Ins. Ins.	Ins. Ins.
Fargate - - -	Redwood	1894	August 1909	15	6	4½ to 3½	1½ to 2½
High Street - - -	Do.	April 1898	Do.	11	6	4 ins.	2 ins.
Haymarket - - -	Do.	May 1898	August 1910	12	6	3½ ins.	2½ ins.
Pinstone Street - -	Do.	June 1898	May 1908 and August 1909.	10	6	4½ to 5½	1½ to 2½

On the Edgware Road, Hampstead, where the traffic amounts to about 10,000 vehicles of all kinds in 12 hours, the actual wear on sectional Jarrah paving in six years, from 1905 to 1911, amounted to only ¼ in.! But, what was extremely important, the wear was equal and uniform, and there was no indication whatever of any corrugation such as complained of with ordinary solid Jarrah blocks.

In Birmingham the wear on creosoted Swedish wood in the busiest streets is about ¼ in. per annum. In New Street, blocks 6 ins. deep wore down to 4 ins. or 4½ ins. in depth, after 10 or 11 years, but, at the entrance to the railway station, in this period they have worn down to 3 ins. in depth.

It is, of course, understood that uniformity in wear is of almost greater importance than hardness which is not uniform. If a pavement wears into holes it cannot be properly cleansed—it becomes insanitary in every way, and experience has shown that creosoted Fir or Pine possesses the quality of uniformity in a greater degree than any other wood.

Repairs.

Repairs.

Little in the way of repairs will be necessary in the first few years of a pavement's life, but periodical inspections are essential, and all defective blocks should be at once removed and replaced with sound ones.

Repairs, including renewals, can be carried out in England, in streets of busy traffic, at a cost of from 9*d.* to 1*s.* per sq. yard per annum.

In some cities it is the custom to adopt the contract system of maintenance—generally at so much per square yard per annum. It is a good plan to tar and grit the surface periodically. This treatment closes up the joints, and renders the paving impervious.

Cost.

Cost.

In England the cost of hard wood paving 4 ins. deep, exclusive of foundation, may be taken at about 10*s.* to 11*s.* per sq. yard; for hard-wood blocks, 5 ins. deep, about 12*s.* to 13*s.* per sq. yard. Sectional Jarrah block paving, 3 ins. deep, costs 11*s.* per sq. yard.

Creosoted deal block paving, 4 ins. deep, costs about 6*s.* 6*d.* per sq. yard, and 5 ins. deep, about 7*s.* 6*d.* per sq. yard. The prices would, of course, vary with market fluctuations, also the price of delivery would affect the price.

Cleansing and Watering.

Cleansing and watering.

The cleansing of wood paving is a very important matter, and consists in sweeping the paving every night with rotary brushes after being well watered. Washing during the day is not recommended, as it renders the surface more slippery for horse traffic.

4th Question.—Resolutions adopted by the Congress.

Resolutions adopted by the Congress.

1. Where gradients permit, wood-block pavement is very suitable for streets where the traffic is great, but is not of the exceptionally heavy character usually existing on streets near docks, or similar centres of industrial traffic. It should be used where a noiseless pavement is desirable. It is of great importance that a concrete foundation should be laid of sufficient strength to carry the traffic passing over the pavement.

2. Great care is necessary in the selection of the proper timber for the purpose, and all soft wood blocks should be thoroughly impregnated with a well-proved preservative before laid.

3. In view of the varying results given by wood pavements, according to local circumstances, it is desirable that further investigations and laboratory experiments should be carried out in connection with the selection of the timber and of the impregnating preservative.

4. Every precaution should be taken in laying the blocks to prevent, so far as possible, the entry of water through the joints.

4A. Hard woods give varying results according to local circumstances, and it does not appear desirable to recommend them for roads with intense traffic in large cities, unless some means are devised to effectively prevent the rapid destruction of the joints and the resulting destructive effect on the concrete below. If these woods are employed it is desirable not only to prevent the percolation of water through the joints to the foundation, but also to consolidate the blocks as far as possible, so that they may not become rounded at the edges.

Soft wood obtained from suitable kinds of trees, and especially from resinous species, are equally suitable for roads with a comparatively heavy and intense traffic as well as for roads with a light and infrequent traffic. In the latter, however, the blocks are liable to rot if they have not been suitably pickled. It is also desirable to make the joints as small and water-tight as possible. On the other hand, their comparatively rapid wear on

roads with great traffic should encourage one to make exhaustive investigations into the best means of treating them, so as to increase their strength without prejudice to their elasticity.

5. Subject to certain precautions, such as impregnating of the wood, waterproofing of the joints and surfaces, frequent cleaning of the roadway, &c., there is no objection to wood pavement from the sanitary point of view.

6. The spreading of gritting is necessary under certain conditions and in certain weather (especially hard wood paving) to prevent the surface becoming slippery, but the gritting should be done with suitable small gravel chippings or sharp sand, so as to avoid, as far as possible, any injury to rubber tyres.

5th Question.—Methods of Lighting.

Section 2.

Special Reporter, Col. Holden, C.B., F.R.S.

This is a branch of the engineering profession generally left to lighting specialists. It is a difficult subject, and is becoming yearly more so owing to new inventions and the increase in the number of lighting systems. The papers submitted were mostly the contributions of men who are lighting engineers by profession, or who have given special study to the subject. Many of the papers are so technical that for their full comprehension a knowledge of electricity and optics is essential.

A very valuable paper contributed by Dr. Clayton Sharp, of New York City, contains many practical suggestions. In considering the principles of street illumination, he says: "The fundamental question is—what constitutes good street lighting?" In dealing with the question he leaves out of consideration "display lighting," *i.e.*, lighting intended to attract the public to certain business streets during evening hours, and limits street illumination to the utilitarian illumination which enables pedestrians, wagon and automobile drivers, to see their way. One of the functions of a general high illumination is as an aid in preventing disorder and crime, but this aspect of the lighting problem is not touched upon by the author. It is pointed out that objects on the street are seen as the result of contrast; that is, of difference in brightness. In the more general case, objects on the street, particularly on streets where the illumination is not of the highest order, are seen by contrasts with their background. Objects which are brighter than their background are seen as objects. Objects which are darker than their background are seen as silhouettes against a background. Objects which are neither brighter or darker than their background are practically invisible.

It appears, therefore, that the character of the background is of very great importance. Now, in viewing objects on the street, the usual background is the street surface itself. The practical condition is that most objects on the street, such as pedestrians, carriages and automobiles, trees, &c., are darker in colour and lower in reflecting power than the street surface itself, and with relatively low illumination they are seen most of the time as silhouettes against the brighter background of the street. In order to bring the visibility of objects to the highest point, it is necessary to make the street surface as bright as possible. Therefore, in street illumination, the proportion of vertical rays should be as high as it can from practical considerations be made.

Effect of character of street surface.

From the foregoing it appears that the character of the street surface is of the greatest importance in determining the visibility of objects thereon. For example, a clean, dry asphalt or water-bound macadam road requires relatively little illumination to render objects visible, whereas an asphalted street which has become blackened from automobile exhausts or by the action of the rain requires a high illumination to produce the same effect.

With water standing on the street the whole surface appears black, except where the light from the street lamps is regularly reflected as in a mirror. The application of oil or tar to roads without the use of a light-coloured top dressing is, from the illumination point of view, extremely bad practice.

Millar in his paper on "An unrecognised Aspect of Street Illumination" devotes considerable attention to the effect of the character of street surface on street lighting, and his comments on the effects of glare will bear reproduction. He says: "A glaring light or surface may be defined as one "which has the effect of diminishing the visibility of adjacent or near by "surfaces or objects. If the street lights are hung in such a way that they "shine in the observer's eyes at the time that he is trying to discern some "faint object, the effect is most disturbing. Arc lamps hung low near the "line of vision and automobile headlights are the most pronounced cases of "this kind, but the effects of glare do not cease with such illuminants." He says: "It would appear therefore that horizontal rays of light from street "lamps are objectionable, and that a suppression of horizontal rays would in "many cases be advantageous. This is manifestly impossible where lamps "are spaced very far apart, but is quite feasible to carry out where the lamps "are close together." Effects of glare.

Glare may be largely mitigated by the use of diffusing globes, at some loss of actual illumination, but at an increase in the seeing power of the eye, and a far greater increase in the comfort of the observer and in the artistic appearance of the installation.

Millar concludes his remarks on the effects of glare in the following passage: "It would appear therefore that, in order to avoid the effects of "glare, it is necessary, first, to raise the lamps well above the field of "vision; second, to suppress the horizontal rays or to redirect them upon the "street surface; third, to use suitable diffusing media about the lamps in "order to reduce their specific brightness."

It is pointed out by Dr. Bell, an American authority on street lighting, that on account of the fact that the intensity of the light decreases with the square of the distance, a greater uniformity of illumination of the street surface may be obtained by the use of smaller units in close spacing.

It appears then that for streets of medium width, provided the illumination is not too low, a uniform, well-diffused illumination is preferable to a brilliant but "spotty" lighting. An alteration of very light and very dark spots is particularly bad for the fast-moving automobilist, whose eyes are rendered insensitive by the bright portions and remain in that condition while in the dark portions. But the principle to be borne in mind in effective lighting is "the ready perception of pedestrians and vehicles in "silhouettes against a moderately bright background."

For the illumination of large open spaces and very wide roads, high power lights placed high up seems to be the best arrangement.

The general opinion appears to be that the most desirable arrangement of light for the purpose of illuminating the entire street is over the centre of the street. The only objection to this arrangement is that it is more difficult to support the lamps in this position, and also that the lines of lamps come directly in the line of vision of an automobilist.

At the intersection of the streets the illumination should be accentuated. Globes and reflectors.

There is a very great difference in glass globes with respect to their absorbing and reflecting qualities. It is very desirable to select a globe that gives the maximum of diffusion with the minimum of absorption. Reflectors play an important part in the efficiency of illumination, and in designing a lamp their effect should be carefully investigated.

The measurement and computation of illumination is described in some of the papers, and the effect of reflection from buildings. Measurement and computation of illumination and effect of reflection from buildings.

Most of the illuminants and lighting apparatus are described by experts, but as much of the information is of a highly specialised nature, it is not proposed to deal with it in this report.

5th Question.—Methods of Lighting. Resolutions adopted by the Congress.

Resolutions adopted by the Congress.

I. For the purposes of a general determination of methods of lighting, highways may conveniently be divided into three classes as follows:—

(1) Important streets in Cities, Towns or other Urban areas in which the traffic after dark is considerable in volume.

(2) Important Suburban roads in the vicinity of large towns.

(3) Rural roads in open country; and having regard to modern conditions of traffic it is essential that adequate lighting by means of fixed lights should be provided in classes 1 and 2.

II. As a general principle in the lighting of all highways which require to be lighted by means of fixed lights, the method of lighting to be adopted should be such as will provide an illumination as uniform and free from glare as possible. The amount of illumination and the position of lamps must be determined with reference to local circumstances.

III. It would be impracticable to light Rural roads in open country generally by similar methods to those adopted in Urban streets or Suburban roads, and the lighting of vehicles running or standing on Rural roads, at night, is therefore of the highest importance.

IV. Every vehicle, whether standing or moving, should carry or show a light of sufficient power at night which can, except when specially authorised, be seen from the rear as well as from the front of the vehicle.

(2) Every motor car must carry, after nightfall, two lighted lamps in front and one at the back; if it is able to move at a high speed it must be fitted in front with a head lamp of sufficient illuminating power to light up the road or path for at least 50 yards to the front. In inhabited places the ordinary lighting is sufficient to allow motorists to see their way and be easily seen, the light of the headlights must be limited to that of the ordinary lamp.

V. It is desirable that all obstacles across a road, such as gates, and particularly gates at level crossings, should be painted white and in other colours in alternate parts, and illuminated by fixed lights which are lighted at dusk.

(2) It is desirable to paint white, or indicate by some other method, all danger signal posts, direction posts and other posts, milestones, wheel kerbs, bridge abutments, &c., or other special features, the indication of which would aid travellers or conduce to the safety and convenience of traffic.

VI. One and the same colour should be adopted as the colour for danger signals.

The meeting, on the proposal of Mr. Chaix, unanimously adopted the following resolution:—

"It is desirable that each Government should do away as soon as possible with coloured lights on automobiles."

On the proposal of Mr. Hausez the meeting adopted the following resolution, with two dissentients:

"The Congress expresses the wish that regulations should be made to *compel drivers of cattle to make their presence known at night.*"

6th Question.—Observations noted since 1908 as to the various Causes of Wear and of Deterioration of Roadways.

General Reporter.

In the papers submitted, considerable attention has been paid to traffic and the design of vehicles, to materials of the road crust, and, to a less extent,

methods of construction. Climate and weather conditions are discussed in a paper relating to urban streets and roads and in one paper administrative and social conditions form the principal theme.

William Gibson Thompson, Editor, *The Surveyor.*

The resolutions passed by the Congress are in themselves an admirable epitome of the views of the different contributors, and I do not, therefore, propose to make a general summary of the papers contributed to this subsection.

6th Question.—Resolutions passed by the Congress.

1. Weather conditions are amongst the most powerful influences which cause deterioration of roads, and that the destructive effect of weather can be minimised by effective waterproofing of the road surface, with suitable drainage for the foundation.

2. Any considerable volume of traffic consisting of either heavy motor vehicles or high speed light motor cars has a seriously damaging effect on waterbound macadam roads.

The damage caused is effected by the balancing of the motor; the ratio between propelling power and adhesive weight; the weight of unsprung portions of the motor; the progressivity of action of the brakes; the system of springing; the type of tyres employed, the diameter of the wheels, the width of the rims, variation of speed and adherence, and other factors.

3. The damaging effect of heavy motor vehicles can be minimised by the use of wheels of large diameter; tyres of a width properly adapted to the weight of the axle load; rubber or elastic tyres and suitable springs, and that all reasonable means of reducing the damage to roads caused by such vehicles should be enforced.

4. Light motor car traffic does not cause serious or exceptional wear or damage in the case of properly made macadam roads which have been properly treated or bound with tarry, bituminous or asphaltic materials, except in sharp curves.

As regards horse-drawn vehicles it is desirable also to study the relations between load, width of rims, and diameter of wheels, and more especially the system of shoeing horses. It is also necessary that powers should be given to Local Authorities to prevent the deposit of refuse from fields and earth upon the roadway by the wheels of agricultural carts.

5. There is still a great lack of precise information in regard to the various causes of wear and deterioration of roadways, and that it is desirable to collect more information compiled on carefully devised scientific methods, standardised as far as possible for the purposes of comparison, and to make further systematic study of these causes.

The International Permanent Commission is charged with the preparation of a programme of observations, studies and experiments.

7th Question.—Regulations for Fast and Slow Traffic on Roads.

Considering how narrow and tortuous many of the London streets are, there is perhaps no city in the world where the traffic is better regulated. Still, much more might be done to relieve congestion by a more intelligent sorting of the traffic and in directing the flow more equally along alternative routes.

It has become the practice to assume that most of the difficulties of the traffic problem arise simply from the advent of the motor, but the public memory is a short one, for congestion in the central area of London was even more marked before, with the much smaller traffic that was horse-drawn.

The contributors of the English report say: "Improvements in methods of "transit have reacted on themselves and produced not only a larger vehicle "movement, but also a marked increase in the passenger circulation. Road

"traffic is now on the increase at all the main outlets of large towns, and "congestion is becoming more accentuated over a larger area each year "accordingly."

Ideal road conditions.

The ideal conditions in a modern city would be main boulevards of sufficient width to permit of their sub division into separate tracks for different classes of traffic; but such conditions, owing to increased site values, are unattainable except in the largest and wealthiest towns. The problem to be faced resolves itself into the necessity of contriving to pass through existing roads, by artificial regulations, a much larger volume of traffic than they would be capable of carrying if the users were left uncontrolled.

Appointment of Traffic Managers and Traffic Board for London.

The authors of the above-mentioned paper recommend the appointment of a traffic manager in all large cities, and for London with its highly complex system of government, a Traffic Board as recommended by the Royal Commission on London Traffic. It is believed that by improved control or by diversion the congestion of the London streets may be sensibly reduced, and a warning is given against yielding to the clamour for large and costly improvements, many of which would take a generation to realise. Much may be done by attention to details. For example, the constant disturbance of the road surface for the laying of mains of all sorts, and for repairs is a most irritating source of delay. Another source of delay, most difficult to reduce, is the crossing of lines of traffic. The gyratory system of distribution as practised in Paris has met with a certain measure of success only in spite of its excellence as a theoretical solution of the problem. The "block" system which obtains in London and other large cities is perhaps the simplest to enforce, but it involves the damming up of the traffic and consequent delay. This system is crude, but it is likely to continue until a better system is evolved admitting of a continuous and uninterrupted flow of the traffic.

Systems of traffic distribution.

Good manners advocated.

The free flow of traffic might be greatly facilitated by good manners on the part of the drivers of all vehicles, particularly in the case of large vans which are apt to overlap the line of traffic they are moving on to the detriment of the overtaking vehicle for which it leaves no room.

It is thought that the charge of incompetence brought against drivers is unfounded, and in my opinion the skill attained by motor car and bus drivers in the London streets is little short of marvellous.

Unnecessary stoppage of public vehicles.

That there is room for improvement in the education of the passengers in tramcars and motor omnibuses there can be no doubt. Old ladies are the chief offenders, but young people are not free from blame, in not alighting at once when the vehicle in which they are travelling is stopped near their destination, whether held up by traffic or stopped for putting passengers down.

Standing vehicles constitute another serious cause of obstruction, but the clearing of them from the streets would probably involve legislation.

Standing vehicles, &c.

Large business establishments involving the loading and unloading of vans in the public street should be compelled in future to design their internal arrangements so that such operations may be carried out inside the premises and not in the public street to the danger and inconvenience of traffic.

The traffic carrying capacities of streets might be enlarged by relegating certain work to the night hours, though in the interests of the inhabitants it is only fair that vehicles so employed should be provided with rubber tyres and the work kept as silent as possible.

The cleansing services are an example of such work. In the City of Westminster the whole of the street washing and the removal of house refuse is already carried out during the night hours, thus clearing the streets during the day of some of the most unsightly and obstructive classes of traffic.

Cab ranks.

The position of cab ranks has always been a thorny subject. It is difficult to abolish them altogether from the streets, but in the majority of instances much improvement ought to result by relegating the main body of the cabs to a side street, keeping only one or two standing in the main thoroughfares provided a call system were installed for the purpose of feeding the main street ranks.

Central obstructions.

Centre lamp and tramway standards, apart from refuges, should be absolutely prohibited as they constitute a great danger to traffic. The central poles for tramway overhead equipment in the city of Bombay (India) have

resulted in many accidents, and their removal to the footpaths is a matter which should receive early attention.

Vehicle licences.

The question of the number of omnibuses and cabs licensed to ply in the public streets is one of great difficulty. In London the system is to grant licences to all owners of omnibuses and cabs who apply for them, with the sole proviso that they must comply with the Police requirements as regards construction. In other cities monopolies are granted for both classes of vehicles. Neither system is satisfactory. On the unlimited plan fresh enterprises spring up, hoping, with the aid of improved vehicles, to wrest the custom from the older companies, with the result that the streets are encumbered with vehicles in excess of the average demand.

It is stated that as an economic proposition it is obvious that the supply of vehicles should be only equal to the average demand, and not to the maximum demand, and it is more in the public interests that the streets should be kept fairly clear, than that no inconvenience should be experienced on special occasions, such as popular fêtes or sudden showers of rain.

If a monopoly is to be granted it must be to the highest tenderer; a proceeding which amounts to a tax on transit, and such a tax is one of the most undesirable for the commercial prosperity of any community.

A better plan would be to grant the monopoly to those who would offer the greatest advantages to the public rather than to firms who would pay the largest sum into the municipal coffers.

Slow traffic.

The keeping of the slow traffic to the sides of the road, which is a Police matter, should be insisted upon. Too many rules for the guidance of traffic is deprecated as leading to irritation. Where streets are wide enough for the purpose, traffic can be trusted to circulate satisfactorily by the mere process of observing the rules of the road, and it is mainly in roads of inadequate capacity that special remedies are required.

It is only when all the expedients enumerated above have been exhausted that the provision of relief roads or the widening of the congested road should be considered. The widening of a busy thoroughfare causes much inconvenience and annoyance to the inhabitants and to the traffic, to say nothing of the enormous expense entailed. Where a suitable relief road can be followed it has decided advantages, for when widening has been effected there is still but one road available, whereas the construction of the relief road provides a second route and avoids all interference with trade and traffic on the existing road.

International signs.

Several writers discuss road signals, and the adoption of international signs, in addition to those authorised at the Road Congress held in Paris in 1910, is advocated.

It should not be difficult for the principal European nations to adopt some standard patterns and colours as they can be universally understood by all road users.

The rule of the road.

A universal rule of the road as to which should be the right side on which to drive would be beneficial to all countries; but there are practical difficulties in the way, based on custom and usage, which would render rules difficult of enforcement.

On the Continent of Europe the rule changes in adjoining countries and one can well imagine how confusing this must be to foreigners.

Driving of several vehicles by one driver.

The writer of the French paper, M. Chai, draws attention to the danger of the practice of driving several vehicles by one driver, and recommends that the man in charge must always be at the head of the leading horse and that there should be not less than one man in charge of every two vehicles.

Priority of vehicles at cross-roads.

The same author suggests that the danger of collision at forked roads should be dealt with by laying down rules. The priority of vehicles using a main highway over those emerging from a side street is generally recognised, but to prevent confusion some definite rule should be approved by the authorities.

As regards pedestrian traffic there seems to be a belief firmly rooted in the minds of most people that a pedestrian is not bound by any rules or regulations; a pedestrian has certain rights, but only equal ones with other road users, and the obligations suggested—that he should give way to an approaching vehicle—certainly entails no particular hardship. The driver

should, however, be held responsible for giving proper warning of his approach.

Parkways. The newer boulevards of American and German cities are in many cases provided with grass strips separating the up and down traffic. These strips are not only ornamental in themselves, but act as refuges for pedestrians, and form valuable amenities as parkways where the inhabitants can indulge in walking exercise in safety, and watch the busy and ever changing life of a big city which is a perpetual source of interest.

Subways. The experiment of erecting subways for pedestrians at busy crossings has been tried; but the evidence of city authorities all over the world is in agreement that they are but little used, the public apparently preferring to take their chance of danger to using the stairs either underground or above ground. Automatic stairs would probably do much to change this state of affairs.

As regards temporary displacements of the surface of the roadway for purposes of repair, fixing of pipes, &c., previously referred to, there can be no doubt that immense inconvenience would be avoided by placing the public services in conduits under the road surface or pavement. This has been done in many of the larger streets in Paris, and Kingsway in London is perhaps the best example of the relegation of all causes of obstruction (including tramways) to a tunnel below the street surface.

Conduits for public services.

Instruction of children. More than one writer lays stress on the desirability of instructing children at school in traffic regulation and rules of the road, and in some countries, such as Belgium and America, much is being done in this direction. It is suggested that with the co-operation of the educational authorities, and assistance from the Press, these rules might easily be made to form part of the regular curriculum in every elementary school.

7th Question.—Resolutions adopted by the Congress.

Resolutions adopted by the Congress. 1. That all regulations for the control of road traffic should be based on the principle of allowing the speed practicable for each different kind of vehicle consistent with public safety, general convenience, and the normal wear of the road.

2. That regulations for the conduct of fast and slow traffic should be as few and simple as possible and should be such as can and ought to be universally adhered to and enforced.

3. That in all large cities there should be a Traffic Authority on whom would be charged the duty of studying and dealing with street traffic problems, and the co-ordination of such powers with those of other public authorities being matters of detail which must be settled by public authorities on consideration of the circumstances and conditions of each large city.

4. That there should be ample provision of traffic controllers (such as the police in London) with adequate powers to regulate the traffic, not only at congested points, but throughout the course of crowded streets.

5. That having regard to the increased danger which is necessarily created by the conditions of modern traffic it is important that drivers should be carefully and systematically trained, and that children should be specially taught how to provide against the dangers of the road.

6. That except where local circumstances render it absolutely necessary, no obstructions, such as lamp-posts, tramway standards, &c., should be placed in the centre of a road, except necessary refuges for pedestrians crossing.

7. No obstruction of the public highway should be permitted either by vehicles standing unreasonably, or travelling at an obstructing speed, or by things placed on the highway. Exception must, however, be made for depôts required for the work of maintenance or repair of the road, or for work being carried out by duly authorised and competent Authorities, but in every case all necessary steps must be taken to ensure the safety of traffic.

8. The meeting, on the proposal of Mr. Chaix, unanimously adopted the following resolution:—

"Regulations for roads and traffic must aim at defining the rights, duties, and responsibilities for each kind of traffic, in order to avoid the causes of accidents and damage and to ensure the maximum of order and liberty."

8th Question.—Authorities in charge of the Construction and Maintenance of Roads—Functions of Central Authorities and Local Authorities.

GREATER CENTRALISATION AND INCREASED STATE CONTROL.

General Reporter, W. Rees Jeffreys, Secretary to the Road Board.

The papers disclose a universal tendency in the direction of greater centralisation and increased State control. In Belgium, where the roads are divided into three classes—one being administered by the State, the second by the Provinces, and the third by the Parishes—the writer of the report urges the need for absolute centralisation of all classes of roads under one Authority. He says: "Can one argue that it is to the public interest that "there should only be one sole administration in charge of the State, pro- "vincial, and parish roads? In other words, is unification of the highway "contrary to the public interest? We should like to know any possible "reason against it. Would the users of the road or motorists complain? "They care little who keeps the road in order so long as the road is kept "in good condition. . . . . Where, then, are we to look for objectors "on the part of the taxpayers? So long as they pay the tax, what "difference can it make to them?

"And as regards the frontagers, will they not be much more easy in "their minds as to the expense of new works? We may therefore consider "that as regards the public welfare, the solution of the highway question by "means of absolute centralisation is not by any means to be considered "impossible from the outset.

"We must, however, admit that there are some dangerous points in this "idea of centralisation which, according to some, is gaining ground owing "to the increased tendency to socialism and communism which does not suit "our country, where we cherish our past history and autonomy."

The German writer arrives at very much the same conclusions, and suggests a uniform technical treatment of the roads of different classes.

The Bulgarian writer says that, after a long period of decentralisation "road works are now absolutely centralised in Bulgaria."

The French writer does not express any definite opinion on the comparative merits of centralisation and decentralisation, but his general conclusion is: "I am thus bound to say that the co-existence of a centralised and "decentralised service between which a fruitful emulation can be established, "benefits the various services, and has produced in France excellent results."

In the United Kingdom, where the strongest opposition has always been shown towards a centralised administration of the roads, the only legislation of recent years has been the establishment of a central authority—the Road Board—for the purpose of administering an annual revenue, about 1¼ millions, in aid of the improvement of roads.

Abolition of small Local Authorities and Establishment of larger Units of Highway Administration.

Abolition of small Local Authorities, &c.

The authors of several of the papers advocate a reduction in the number of highway authorities. It is contended that greater economy is secured by larger units of highway administration, and that a better trained and more

intelligent staff is attracted by the better conditions of pay and service which larger bodies are able to afford. One of the most persistent charges brought against small administrations is that they do not employ good men; and this is excusable to some extent for financial reasons.

Mr. Munro Ferguson, M.P., in his notes on Scotland, in referring to the greater economy that is secured when the area of administration is large, says: "Again, I know several Local Government Areas where the steam-" roller and all the other machinery is not employed half the year. There " would be a great saving in the provision and the maintenance of the road " equipment with larger areas including all the smaller and medium " Burghs.

"In Scotland there are over 200 Burghs all of which are independent " units for highway administration. Half of these have probably less than " 10 miles of road to maintain."

Higher Salaries and better Organisation.

The provision of a trained and qualified staff is an all-important matter The views of some of the writers on this subject are given below.

Higher salaries and better organisation.

The authors of the English paper state: "On any new system of high-" way administration it should be clearly established that none but properly " qualified surveyors should be employed by County, County Borough or " District Authorities, and that the foremen and other men employed on the " roads should be skilled and competent workmen and not men who are old " and decrepit and unable to follow any other employment."

Mr. Sargent, of the United States, writes: "One influence of State aid " has been to discourage the promiscuous selection of men to take charge of " road affairs. The people are learning that road building is an art based " on a science, and that trained men and men of experience are necessary to " secure the best results from the expenditure of road funds."

The Bulgarian writer states that "the staff should be recruited with " great care. The directing staff should be selected from the staff of the " active services. There should not be among the staff persons who do " not know their profession."

The State and the Roads.

The State and the Roads.

The States, or the central Government, of nearly every country has been loth to undertake active responsibilities in connection with the roads, and every function it has assumed in connection with the roads has been forced upon it by events against its own will.

On the Continent of Europe, many of the countries have the most centralised system of road administration. Military considerations no doubt contributed to bring about this centralisation.

England, United States, Canada, where military reasons have not operated, have been the last to adopt any form of central administration.

The development of road transport has thrown a burden on Local Authorities which they are unable to bear, forcing the Governments of these countries to assume new responsibilities.

In the United Kingdom it is shown by the institution of the "Road Board": in the United States by the institution of a Federal Department to advise the Local Authorities and assist as an Intelligence Department and by the creation of State Highway Departments in the individual States of the Union.

In Canada and Australia similar steps are being taken. The fact, which a study of all countries brings out, is that this increased centralisation is not due to any initiative on the part of the Government themselves. The burden of the cry of all local road administrations is that they are required

to maintain long lengths of main and even national roads, towards the cost of which they are entitled to receive State assistance, inasmuch as the bulk of the traffic using such roads is not local, and that therefore the burden of expense does not fall on the proper shoulders.

With the exception of the Minority Report which appears in the paper submitted by the United Kingdom, the ideal of a centralised authority meets with favour.

Many of the reasons adduced in the Minority Report deserve consideration. They may be briefly summarised as—

(1) Centralisation introduces too much officialism ;
(2) A central authority does not possess local knowledge or take proper notice of local sentiment and feeling ;
(3) Centralisation secures uniformity at too dear a price ;
(4) Centralisation leads (in some cases) to the authorities exercising jurisdiction over an area ; and
(5) The cry for centralisation comes from the users of the roads who are not local ratepayers.

The General Reporter, Mr. Rees Jeffreys, the Secretary of the Road Board, deals with these objections in an able manner. He points out that the day of the amateur road-maker is past. Until within quite recent times there was a common belief that any parishioner was qualified as a road surveyor, and English local legislation was based on this belief. A very different view is now gaining ground, for road-making has now become a highly expert department of human knowledge, requiring trained men who have devoted their lives to the study of the subject. It is in the appointment and selection of competent engineers that minor authorities in England and in other countries have broken down. Really first-class men can only be attracted by the payment of good salaries, and it is often financially impossible for small bodies to employ such men. Small authorities are often composed of men with limited outlook and limited incomes, and it cannot be expected that they will willingly appoint as their servant an officer whose knowledge, standing, and emoluments are much greater than their own. The suggestion as to securing local information and considering local feeling is perhaps a good one, but the General Reporter doubts whether it is necessary to create small executive bodies to secure it. He thinks that a form of organisation capable of securing local information could be worked into and form part of a larger organisation.

Local Authorities administering small resources possess, as the German writer has stated, an "uncontrolled instinct of economy," and as the history of highway administration in England has demonstrated over and over again, they are unwilling to spend any money on improving roads to meet demands greater than those of the locality itself. This uncontrolled instinct of economy is often more costly than the most extravagant expenditure.

"Centralisation secures uniformity at too dear a price" is the third objection. There is a danger that a highly centralised bureaucratic form of government out of touch with the local feeling may produce this result. Extreme decentralisation often results in inefficiency and lack of adaptation of means to ends ; centralisation tends to produce a costly uniformity and lack of initiative. It is possible that in a happy combination of properly constituted local authorities working in partnership with a central authority that the solution of the problem will be found.

The two last objections, which are of a local character, might be overcome by readjustment of highway authorities ; the introduction of a larger unit of administration and redistribution of the financial burden.

Many of the reports deal with the question of Centralisation *v.* Decentralisation in road administration, and, as the General Reporter truly says, "People must work out their own salvation like individuals." There is no sign that countries like France and Belgium are likely to retrace the steps they have taken in the direction of centralisation. The effect of the sizes of areas on the financial burden, Road Classification, Organisation of Staff, Training and Recruiting of Engineering Staff are all exhaustively dealt with in the many excellent papers contributed to this section.

8th Question.—Resolutions adopted by the Congress.

Resolutions adopted by the Congress.

1. The system of road administration in any country must be in harmony with the general system of Government prevailing in that country and the political genius of its people. It is impossible to lay down any general rule of universal application as to the extent to which the road organisation of any country should be centralised or decentralised.

2. A principle that can be laid down as of universal application is that the unit of highway administration shall be sufficiently large and command sufficient resources to employ and adequately remunerate a competent staff.

Finance of the Construction and Upkeep of Road—Provision of Revenues.

General Reporter, E. Montagu Harris, M.A. Barrister-at-law, Secretary to the County Councils' Association of England and Wales.

A large number of papers were submitted on this difficult and complex subject. In several countries on the Continent of Europe the State bears the whole cost of maintaining roads classified as National, and when local authorities make a contribution towards the cost of such roads it is based in each case on a calculation involving a number of factors. On the other hand the rough and ready methods of Great Britain are based on no principle whatever, and are altogether unsatisfactory.

The General Reporter thinks that the simplest method which would be approximately fair all round, where the cost is to be shared by the State and the local authorities, would be for the State to bear a fixed proportion of the cost subject to their inspectors being satisfied that the road is being efficiently maintained, and in the case of national roads it is generally held that the State's share of the expenses should be not less than 75 per cent.

9th Question.—Resolutions passed by the Congress.

1. The expenditure of the maintenance and improvement of—

(*a*) the roads which serve as main routes of communication between important places in any country, or

(*b*) roads which are used mainly by long distance traffic;

unless such expenditure is borne wholly out of the National Revenues under a system of State administration of roads (which system is practicable and suitable in the case of some roads in some countries) should be mainly paid out of National Revenues, whether or not such roads are locally administered and maintained, subject, where local administration prevails, to the supervision of a central Government Authority both as to efficiency and expenditure.

2. It is desirable to abolish, so far as possible, all tolls on public roads, but it is equitable that vehicles which, on account of their weight, or weight combined with speed, or any other exceptional circumstances connected with either the vehicle or use of the road, cause special damage to roads beyond the wear and tear of the ordinary traffic of any district, should be subject to special taxation, the proceeds of which should be earmarked for expenditure on roads.

3. Borrowing money for new road construction and for the periodic renewal of the surface coating of a road is consistent with sound financial principles provided the loan period in the case of loans for renewals is kept well within the life of the surface coating.

In concluding my report on the Third International Road Congress I desire to call attention to the extract from letter No. 978 W., dated the 6th March 1912, from the Public Works Secretary to the Honourable the Chief Commissioner, Central Provinces, to the Secretary to the Government of India, Public Works Department (copy attached).

I regret that, owing to the lateness of my appointment as representative of the Government of India to the Road Congress, it was not possible for me to collect information from Local Governments in India in connection with questions to be considered by the Congress. A paper on Indian roads dealing with the different types, and the influence of climatic and physical conditions would, no doubt, have been of interest, but for the writing of such a paper a large mass of information would have had to be collected from different parts of India for which time did not permit.

As regards figures of cost, I have in the body of my report referred in a number of instances to rates for carrying out different types of road surfacing, but conditions in India are so very different from those obtaining in England that any attempt at comparison would be of little or no value.

In Europe and America the chief element in the question of cost is "labour." Rock from which road metal is produced is of very little value, as rock, but to quarry and break it to suitable dimensions for use on the road labour has to be employed, and in all the processes through which the stone passes till the road is ready for traffic, the cost of labour is the item of expenditure which exceeds all others, and it is to reduce this item that labour-saving machinery of different kinds is now increasingly employed. In India where wages are low, and, except in a few instances, manual labour can hold its own with machinery, the cost of road construction is much lower than in Europe, and even in Europe there is very little uniformity in the matter of cost as so much depends on local custom *e.g.*, wages, carriage, &c. A comparison between the roads of India and the modern roads of Europe would serve no useful purpose. A road should be adequate for the traffic it has to carry, and anything more than this is wasteful. To pave the Strand with water-bound macadam would be almost as foolish as laying granite setts or wooden blocks in a country lane. The whole question is one of users, and viewing the roads of India as a whole they are, in my opinion, well adapted and sufficient for existing needs. Except in the big towns motorists are microscopic in numbers, and for many years to come their importance will not justify any radical change in the nature of the road crust.

I do not wish to convey the impression that the existing roads are not susceptible of improvement; much might be done to improve their wearing qualities by more skilled methods of construction. Greater attention to small details, such as breaking and grading of stone so as to reduce the voids and thus add to the life of the road is desirable.

In expressing satisfaction with the district roads of India I refer to the "type" of road only—the ordinary water-bound macadam road—and it is to improvements in this type that the attention of the Public Works engineer should be directed.

In the large cities such as Bombay, Calcutta, Madras, and some of the more important towns in Northern India the traffic is of sufficient intensity and destructiveness to demand a more durable road crust. In the vicinity of docks and mills, where traffic is heaviest, long lines of bullock carts with narrow tyres and wheels with considerable side play along their axles, moving in the same track, are most destructive, and no ordinary macadam road can stand such treatment for long.

It is under such conditions that a more expensive and lasting type of road surface is called for. The dislocation of traffic and the general discomfort caused by constant renewals of a road surface are apt to become intolerable and for this reason alone the public are entitled to every consideration at the hands of the highway authorities.

Of the most expensive types of road surface wood blocks and stone setts have been found to give the best results under the heaviest traffic. It is doubtful whether wood blocks would be suited to India with its variable climate, even if laid under the most approved modern methods. The cost of wood paving is so great, and its success under Indian conditions so uncer-

tain, that it would be unwise to introduce it on a large scale until after carrying out a prolonged and systematic series of tests. The great drawback to wood is its lack of uniformity in texture and hardness and other qualities that are necessary for a good street pavement. A few years ago the engineer of the Bombay Improvement Trust had a small area of road laid with Jarrah blocks, but the experiment was most disappointing. Whether the wood had been thoroughly seasoned or not it was impossible to say, but the blocks lifted as the result of expansion and were thrown about the road.

Granite stone setts are ideal for heavy traffic where noise is not objected to, but this type of surface is as expensive as wood, although more lasting.

"Durax" armoured paving, which consists of granite cubes grouted with tar, having a finished depth of paving of about 3½ inches, seems to be gaining in favour in England for heavy traffic. Section 5 of the trial lengths of road surface laid down by the Kent County Council, by arrangement with the Road Board on the New Eltham-Sidcup Road, has been laid with this material with satisfactory results. It is described in the Interim Report of the Road Board (copy attached). It would be interesting to make a trial of this system using blocks of the hard basaltic rock which is so plentiful in India.

A detailed account of trials with several of the principal proprietary tar and bitumen compounds will be found in the above publication and in the body of this report. It would be worth while importing several tons of these different materials such as Pitchmac, Tarmac, Mexphalte, Ferromac, &c., the makers being informed beforehand of the climatic conditions under which they would be used.

In conclusion, I wish to express my indebtedness to Mr. Rees Jeffreys, the Secretary of the Road Board, for furnishing me with copies of the Road Board annual reports and other information, and to Captain Kingston, Assistant Secretary, for his courteous assistance in a number of small ways.

The Secretary to the Road Board has asked my assistance in obtaining information from India to enable him to make as complete as possible Appendices 6 and 7 (copies attached) of the annual report of the Road Board. Appendix 6 is a table showing (1) length of roads in each country, classified according to the character of their construction; (2) the total annual expenditure upon construction and maintenance; and (3) the sources from which such expenditure is derived.

It will be seen that the information furnished from India is very incomplete, only Bombay and Burmah having given any information at all. The same applies to Appendix 7. It is suggested that reliable and complete information could be obtained if the Government of India were to call on local administration and Native States to submit an annual statement on the lines adopted in the Appendices, and that the information so obtained be embodied in a single statement and forwarded annually to the Secretary to the Road Board.

R. J. KENT.

Accompaniments:—

General Programme, 3rd International Road Congress.
Official Catalogue—Exhibition of road-making appliances and materials.
Road Board Specification No. 7. General Directions for Surfacing an Existing Road with Steam-rolled Water-bound Macadam.
The Road Board General Directions and Specifications relating to the Tar treatment of roads.
Interim Report of the Road Board on trial of road materials at Sidcup, Kent, &c.
Appendices 6 and 7 of Road Board Annual Report.
Copy of extract from letter No. 978 W., dated 6th March 1912, from the Public Works Secretary to the Honourable the Chief Commissioner, Central Provinces, to the Secretary to the Government of India, Public Works Department.

Since writing the portion of this report dealing with the Road Board their Third Annual Report has been issued. Hitherto very little in the way of parliamentary criticism had been directed against the administration of the Board, but last year's report seems to have given rise to a good deal of discussion, and several members spoke at length on the policy of the Board.

Mr. Hoare, in order to call attention to the administration of the Road Board, moved to reduce the salary of the Chancellor of the Exchequer. He complained that the Board had not been spending as much money as it should have been spending, and instanced the fact that out of a total revenue of £3,525,995 up to June 30th last it had only distributed one million.

The method of allocating grants to various parts of the United Kingdom on the basis of population was wrong in his opinion. By that test England and Wales were not receiving their fair share. London, he argued, had contributed no less than £600,000 to the funds of the Board, while the grants made to the London County Council area amounted to only £53,534.

Mr. Hayes Fisher said there was no other department of the State which was allowed to hoard money as the Road Board was; every other Department had to hand over its unexpended balances.

Mr. Leif Jones considered that the House of Commons should have more control over the expenditure, but he believed that the Road Board was wise in going slow with regard to the expenditure of its funds; and in this he was supported by Mr. Mitchell-Thomson, who said that if the Road Board had rushed in and made improvements at the earliest possible moment much of the money now in hand would have been wastefully spent.

Mr. Lloyd George (Chancellor of the Exchequer) replying on the debate, pointed out that the Treasury was only nominally responsible for the administration of the Road Improvement Board. It had only the power to veto, and this arrangement was the deliberate act of Parliament. The only alternative to the machinery of the Road Board was to adopt the suggestion that the fund should be distributed nationally, in which case they could hand over the money to the Local Government Board in each county.

As to the complaint that London, which contributed a very considerable sum of money towards the fund, did not get its fair share of grants, the Chancellor pointed out that although licences were paid in London, and very often petrol was stocked in the Metropolis, and, therefore, the actual contribution of the revenue was made within that area, the roads which were torn up were outside London. It would, therefore, obviously be unfair to treat the London revenue as if it were revenue that ought to be spent purely upon widening and improving London streets. It was pointed out that the Road Board had offered a sum of £870,000 towards the proposed new western approach road, which would be for the benefit of London as a whole, but it was a scheme which would take a long time to mature. The Chancellor expressed the hope that the House of Commons would not press the Road Board to scatter their funds now; and he shrewdly remarked that a properly thought out idea, with the cash in the bank, was infinitely better than a haphazard measure, improvised in a few hours, of doing something nobody wanted.

On reading the Road Board report it will be seen that although out of a total revenue of £3,329,420 up to the 31st March last, only payments to the extent of £701,689 were actually made, a no less sum than £2,208,381 was indicated in the shape of grants, and £611,839 as loans, leaving a balance of £451,755 as net receipts in excess of commitments.

In allocating loans the method of procedure is as follows:—

The county council of each county when considering its estimates and programme of work for the ensuing financial year, submits to the Board a general statement indicating, frequently in quite general terms, a list of the works which are in contemplation.

This statement is followed up by an interview or interviews between the Board and some representatives of the county council, and after discussion the Board consider whether a grant should be indicated.

When a grant is indicated the local authorities are requested to prepare and submit details and specifications of the selected works, and the exact

figures having been ascertained, the Board submit each case to the Treasury for sanction, when a formal grant is made.

But considerable delay occurs between the indication of grants and the submission by the authorities of the final details for completion of the grant. This is to some extent unavoidable, as it is frequently necessary for the representatives of the highway authorities to submit the definite proposals to council meetings so as to get authority to proceed. Hence delay between the indication of a grant by the Board and the final completion of the grant is unavoidable. Meanwhile, however, the Board having indicated or definitely promised a grant or loan, must treat that indication as a commitment for which financial provision must be made. It has already been pointed out that the policy of the Board, laid down by statute, is to provide some measure of employment to labour in times of local distress, and if the Board are to carry out the intentions of the Act it means the holding over of certain road improvements till such time as there is a local shortage of work.

These explanations satisfactorily meet the charge brought against the Board of hoarding their funds. It is an easy matter to waste public funds on works of road improvements and repairs, and the Board are no doubt right in investigating applications for loans thoroughly before making grants.

R. J. K.